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FROM COMMENCEMENT ADDRESS, 1961*

Douglas MacArthur

OVERSHADOWING ALL OTHER PROBLEMS you will face, intruding upon every thought and action, encompassing all that you hold most dear, dictating not only the past but your very future, is the master problem of global war. How, you can well ask, did such an institution as war become so integrated with man's life and civilization? How has it grown to be the most vital factor in our existence?

It started in a modest enough way as a sort of gladiatorial method of settling disputes between conflicting tribes. One of the oldest and most classical examples is the Biblical story of David and Goliath. Each of the two contesting groups selected its champion. They fought, and based upon the outcome, an agreement resulted. Then, as time went on, small professional groups known as armies replaced the individual champions. And these groups fought in some obscure corner of the world, and victory or defeat was accepted as the basis of an ensuing peace. And from then on, down through the ages, the constant record is an increase in the character and strength of the forces with the rate of increase always accelerating. From a small percentage of the population it finally engulfed all. It is now the nation in arms. Within the span of my own life I have witnessed much of this evolution. At the turn of the century, when I joined the Army, the target was one enemy casualty at the end of a rifle, a pistol, a bayonet, a sword. Then came the machine gun designed to kill by the dozens. After that the heavy artillery raining death upon the hundreds. Then the aerial bomb to strike by the thousands—followed by the atom explosion to reach the hundreds of thousands. Now electronics and other processes of science have raised the destructive potential to encompass millions.

* General of the Army Douglas MacArthur delivered the Commencement Address at Michigan State University, June 11, 1961. This is the concluding portion of his Address.

And with restless hands we work feverishly in dark laboratories to find the means to destroy all at one blow.

But this very triumph of scientific annihilation—this very success of invention—has destroyed the possibility of war being a medium for the practical settlement of international differences. The enormous destruction to both sides of closely matched opponents makes it impossible for even the winner to translate it into anything but his own disaster.

The late war, even with its now antiquated armaments, clearly demonstrated that the victor had to bear in large part the very injuries inflicted on his foe. We expended billions of dollars and untold energies to heal the wounds of Germany and Japan.

Global war has become a Frankenstein monster to destroy both sides. No longer can it be a successful weapon of international adventure. If you lose, you are annihilated. If you win, you stand only to lose. No longer does it possess even the chance of the winner of a duel—it contains now only the germs of double suicide.

Time was when victory in war represented a shortcut to power, a place in the sun, economic wealth, and accelerated prosperity. It was the final weapon of statecraft, the apotheosis of political diplomacy. Its application, however, was regulated, controlled, and limited by the basic principle that a great nation that entered upon war and did not see it through to victory would ultimately suffer all the consequences of defeat. This is what happened to us in Korea. With victory within our grasp, and without the use of the atom bomb which we needed no more then than against Japan, we failed to see it through. Had we done so, we would have destroyed Red China's capability of waging modern war for generations to come. Our failure to win that war was a major disaster to the free world. Its fatal consequences are now increasingly being felt in the military rise of Red China into a mighty colossus which threatens all of continental Asia and bids fair to emerge as the balance of military power in the world. This would jeopardize freedom on all continents.

But the conditions that prevailed in the Korean War exist no longer and will come no more. Then we were the sole possessors of nuclear power; we stood alone in military might. Now all this is changed. Others possess this weapon. Relative strengths from now on will probably change little with the years. Action by one will promptly be matched by reaction from the other.

The great question is, can global war now be outlawed from the world? If so, it would mark the greatest advance in civilization since the Sermon on the Mount. It would lift at one stroke the darkest shadow which has engulfed mankind from the beginning. It would not only remove fear and bring security; it would not only create new moral and spiritual values; it would produce an economic wave of prosperity that would raise the world's standard of living beyond anything ever dreamed of by man. The hundreds of billions of dollars now spent in mutual preparedness could conceivably abolish poverty from the face of the earth. It would accomplish even more than this; it would at one stroke reduce the international tensions that seem to be insurmountable now to matters of probable solution. This would not, of course, mean the abandonment of all armed forces, but it would reduce them to the simpler problems of internal order and international police. It would not mean Utopia at one fell stroke, but it would mean that the great roadblock now existing to the development of the human race would have been cleared.

You will say at once that although the abolition of war has been the dream of man for centuries every proposition to that end has been promptly discarded as impossible and fantastic. But that was before the science of the past decade made mass destruction a reality. The argument then was along spiritual and moral lines, and lost. But now the tremendous evolution of nuclear and other potentials of destruction has suddenly taken the problem away from its primary consideration as a moral and spiritual question and brought it abreast of scientific realism. It is no longer an ethical equation to be

pondered solely by learned philosophers and ecclesiastics but a hard core one for the decision of the masses whose survival is the issue. This is as true of the Soviet side of the world as of the free side—as true behind the Iron Curtain as in front of it. The ordinary people of the world, such as you and I, whether free or slave, are all in agreement on this solution; and this, perhaps, is the only thing in the world they do agree upon, but it is the most vital and decisive of all. We are told that we must go on indefinitely as at present—with what at the end none say—there is no definite objective. The search for a final solution is but passed along to those who follow and, at the end, the problem will be exactly that which we face now.

It may take another cataclysm of destruction to prove the bald truth that the further evolution of civilization cannot take place until global war is abolished. This is the one issue upon which both sides can agree, for it is the one issue upon which both sides will profit equally. It is the one issue in which the interests of both are completely parallel. It is the one issue which, if settled, might settle all others.

The present tensions with their threat of national annihilation are fostered by two great illusions. The one is a complete belief on the part of the Soviet world that the capitalistic countries are preparing to eventually attack them and that sooner or later we intend to strike. And the other is a complete belief on the part of the capitalistic countries that the Soviets are preparing to attack us and that sooner or later they intend to strike. Both are wrong. Each side, so far as the masses are concerned, is desirous of peace. Both dread war. But the constant acceleration of preparation may, without specific intent, ultimately precipitate a kind of spontaneous combustion.

Many will tell you, with mockery and ridicule, that the abolition of war can be only a dream, that it is but the vague imaginings of a visionary. But we must go on or we will go under. And criticism is that the world has no plan which will enable us to go on. We have suffered the blood and the sweat

and the tears. Now we seek the way and the truth and the light. We are in a new era. The old methods and solutions for this vital problem no longer suffice. We must have new thoughts, new ideas, new concepts. We must break out of the strait-jacket of the past. We must have sufficient imagination and moral courage to translate this universal wish—which is rapidly becoming a universal necessity—into actuality. And until then we must be fully prepared, whatever the cost or sacrifice, lest we perish.

THE ROAD TO PEACE: A PERSONAL VIEW

K. Zilliacus

THE EDITOR OF THE CENTENNIAL REVIEW has asked me to contribute an article on how I see the problem of ending the arms race and the cold war. I gladly comply, for the more who are seriously concerned about saving world peace and who can keep in touch across frontiers and consider each others' views, the better for our common cause. I refer, of course, to those who are not burdened with briefs to defend official policy, but are free to speak their minds. In this connection, I believe mutual understanding between the British Left and American liberals is of particular importance. For, although I have no use for the present military alliances (NATO, CENTO, and SEATO), I believe a working partnership between our two countries within the United Nations for purposes consistent with its Charter could be a corner-stone of world peace.

The background against which I write is that of (a) two years as Intelligence Officer in the British Military Mission in Siberia, from start to finish of intervention against the Russian revolution at the end of the first World War (I kept the War Diary of the Mission, based on all the information available to us from all sources; (b) handling the super-secret personal correspondence, in a cipher no-one else was allowed to use, between the head of the Mission, General Sir Alfred Knox, and the Minister for War, Winston Churchill, who was running intervention as his personal policy; and (c) nineteen years as a Member of the Information Section of the League of Nations Secretariat, during which time part of my duties was to keep in touch with Soviet affairs, as well as with the Labour Party and the Second International. (I joined the Labour Party on demobilization in 1919 and, while at Geneva, became its backroom boy and confidential adviser on foreign affairs, particularly when Arthur Henderson was

Foreign Secretary in the Second Labour Government; I was seconded from the Secretariat to act as his Personal Assistant during the years he was president of the Geneva Disarmament Conference, which, like old soldiers, never died but only faded away). In 1945 I was elected Labour Member of Parliament; I was expelled from the Party in 1949 for persistently and consistently opposing the Labour Government's [Tory] foreign policy, and bawled out at the same time by Moscow for saying Tito was right to reject Stalin's attempt to tell him how to run his own country. I was readmitted in 1952, got back to the House in 1955, and was re-elected in 1959. After the Russians made it up with Tito in 1956, they saw no reason for a quarrel with me. In short, I got into trouble for being a premature peaceful coexister and a premature Titoist, but time has caught up with these positions.

I

Today, in the age of nuclear energy and ideological conflict, our conception of freedom as a way of life, as part of the good life, an end in itself, man's highest achievement to date in the difficult art of life in society, of reconciling the rights of the individual with membership of a community, can survive only if our conception of democracy as a system of government proves capable of solving the two basic and interrelated issues with which we are confronted:

The first is how to absorb the results of the technological and scientific revolution, the vast new productive forces now at our command through automation, electronic techniques, and atomic energy into our economic system. The second is how to live at peace with the one-third of the world who have sought a solution of that and cognate problems through social revolutions and the building of a new economic system based on public ownership, production for use instead of profit, and planning for social purposes.

So far, the leading Western democracies have failed to solve the first problem and have rationalized their failure and the

need to cope with its consequences by adopting policies toward the second problem which are not only futile and are passing from failure to collapse, but are increasingly dangerous to the survival of the human race. For just as they will not see the need to make fundamental changes in our social and economic system in order to adapt man to the new forms of production, so they will not understand that it is impossible to defend anything with weapons which would destroy everything. Moreover, the rulers of the Western World and the press and other media for large-scale distribution of news and views have enveloped the whole subject in such an atmosphere of panic, fear, and fanatical self-righteousness, and present the people with such a distorted and fragmentary picture of reality, that the voice of reason can be heard only faintly and by a few.

British policy toward the Soviet Union since the first World War, which ultimately became Anglo-American policy, with the U. S. passing into the lead from about 1947, toward the countries of the social revolution in one third of the world, has pretty consistently used wrong methods, has been based on false premises, has failed in practice, and will, unless defeated and/or abandoned in time, provoke a nuclear war of extermination which no one wants. Above all, it is not a rational policy, for it proceeds from emotionally apprehended, largely subconscious social motives and bears little relation to international realities.

At the close of the first World War, there were a social revolution in Russia, political and agrarian revolutions in several countries, and revolutionary unrest throughout Europe. This situation was met first by armed intervention to crush the Russian revolution. This policy was "sold" to the public at home as "defense of democracy and freedom." But in point of fact the Tsarist Generals and Admirals we were backing were out to establish a military dictatorship of their own. And as the then Foreign Secretary, Lord Balfour, pointed out in a memorandum circulated to the War Cabinet in July, 1918, (and later reproduced in Lloyd George's *War Memoirs*), an

autocracy in Russia restored by intervention would be aggressive and expansionist in the Middle East, strive to recover Poland and Finland, and would become dependent on and allied with autocracy in Germany. That is, if intervention in Russia had succeeded, Fascism would have spread more quickly in Europe, Hitler would have climbed to power sooner, and the second World War would have started earlier, with Nazi Germany and the Russian military dictatorship fighting as allies. Fortunately, intervention failed. But it was responsible for starting the Terror, it cast the Soviet regime into a far harsher and sterner mold than it would have developed into otherwise, and it paved the way for the triumph of Stalin after Lenin's death. Without question, it scarred and mauled the infant Soviet regime so badly as to make it less attractive and make the price of social revolution appear prohibitive to workers in other countries.

On the other hand, intervention in Europe by indirect military (use of the Rhineland Army of Occupation to "freeze" the social *status quo,* letting loose the Roumanian Army on revolutionary Hungary, etc.) and direct diplomatic, "humanitarian," and economic means (tying political strings to food for starving people, the granting of loans, etc., backed by threats of what would happen if the beneficiaries turned to Socialism), did succeed in saving the old order in Europe. Had it failed, most of Europe would have gone Socialist, in varying forms and with more democracy and freedom than under Fascism. Then there would not have been a second World War, nor the present arms race and cold war. But intervention in Europe succeeded at the price of promoting the spread of Fascism and the appeasement of the Fascist powers (that is, conniving at the treaty-breaking rearmament of Germany and the aggressions of Hitler and Mussolini) which thereby made inevitable the utterly unnecessary second World War and which could have been headed off again and again if we had really tried to apply the obligations of the Covenant, instead of treating them as a scrap of paper. (Although had we done so, the defeat of the Fascist regimes would have

been followed by their downfall and social revolutions.)

Halfway through the second World War this policy was resumed, at first secretly, later publicly. As formulated by Winston Churchill at Fulton, Missouri, on March 5, 1946, and by George F. Kennan in his famous "Mr. X" article in FOREIGN AFFAIRS of July, 1947, it was a policy for concluding a military alliance between the U.S.A., the British Commonwealth, and Western Europe, which would encircle and isolate the Soviet Union with a ring of hostile bases and forces all around her frontier, and be strong enough, thanks to the U. S. monopoly of the atomic bomb—then believed to be the "absolute weapon," which had reduced the Soviet Union to the status of a second class power—to enable the West to "negotiate from strength," *i.e.*, impose its will under threat of war. The will of the West, as defined by Churchill, was first, to halt, and then to "roll back" Communism (confused with any serious threat to the old social order, and identified with "infiltration and subversion by 'Soviet aggression' ") to the frontiers of the Soviet Union; this meant the withdrawal of Soviet forces from Eastern Europe, and the advance of Anglo-American forces from Western Europe, sponsoring and supporting counter-revolutions to overthrow the "Popular Front" coalitions which had emerged from the resistance movements and which had taken power in the countries where the Nazis and their quisling regimes had been driven out by the Soviet Union. Mr. Kennan went further and claimed that this policy would, by frustrating and hemming in the Soviet government all round its frontiers, put such strains on the Soviet regime as to bring about its transformation or collapse.

This policy reflected the outlook of the *beati possidentes*, the Establishment, power elite, ruling class, or whatever one may call them, who regard the existing social order, where they have power and privileges, as part of the order of nature, and believe there is no feasible, let alone preferable, alternative to it, but only "red ruin and the breaking up of laws." This outlook is not a matter of reason, but rather a condi-

tioned reflex, organic and providing built-in terms of reference and thought barriers. It follows from this conditioned reflex that social and colonial unrest cannot be due to indigenous causes, to shortcomings and wrongs in the existing order so serious that peoples denied redress by democratic means rise in revolt, but must be the work of foreign agents ("infiltration and subversion").

This conclusion leads to the great Tory syllogism, which has for the last 44 years constituted the crazy intellectual and moral foundation of the policy of the defenders of the old order toward the countries of the social revolution and the forces of change in the world: social and colonial unrest is Communism; Communism is Soviet aggression. Therefore, defense (of our country, our way of life, freedom, religion, etc.) is counter-revolutionary intervention by diplomatic, economic, and even military means; to impose, maintain, or restore regimes, however dictatorial, corrupt, reactionary, and bloody, which are safe for the old order; and to put down popular movements or to overthrow governments hostile to the old order. This conception of "defense" is to take the form of engaging in small wars with conventional arms, backed by the threat of all-in nuclear war if the victims of these attentions receive help from outside.

II

This policy is not a mere aberration. It is the rationalization of the need of the die-hard defenders of "free enterprise" for massive war preparations to avoid the old order foundering in mass unemployment, and for the cold war as the anti-Socialist opium of the people. In fact, of course, as George F. Kennan and other competent witnesses have repeatedly testified, the Soviet leaders have no intention of using war as an instrument of national policy or of imposing Communism by force of arms on other countries. "As to the basic question whether the Soviet Union would be prepared to use her military forces for ideological purposes, all foreign observers

agree that she will use them only to protect her national security," wrote Mr. Henry Brandon, normally the Washington correspondent of the Conservative SUNDAY TIMES (Aug. 2nd, 1959), after a visit to Moscow. "Mr. Khrushchev," he added, "believes that Russia's growing prosperity and power will become sufficiently contagious to promote world revolution by peaceful means."

That is the truth. In the conditions of international anarchy and power politics to which we have returned, on the initiative of the West after the war, the Soviet Union will use force just as ruthlessly to protect its view of its vital interests, particularly its security interests, and ride rough-shod over the rights of small states in so doing, as any other great power. Hungary is a case in point. There the Soviet Union has behaved exactly as the Western powers have undertaken to behave in CENTO and SEATO: it intervened, at the request of a government dependent on itself and allied to it, to "defend" it against "infiltration and subversion" by "agents from the West," by putting down a popular rising against tyranny. (In international law, that was on all fours with U. S. intervention in Lebanon and British intervention in Jordan in 1958, although it was far bloodier in execution; it was less clearly a case of international aggression than the official Anglo-French attack on Egypt and the semi-official C.I.A. attack on Cuba.)

But the Soviet government has never, again as G. F. Kennan has pointed out, believed that it was good Marxism or a Russian national interest to impose Communism on other countries by force of arms. If that had been the Soviet view, the Soviet government would have tried forcibly to Communize Finland, then technically an enemy State, when in occupation of that country at the end of the war and given a free hand by Britain and the U.S.A. to do what it liked. And if that were the Soviet view, the Soviet government would not have offered to withdraw its forces from Eastern Germany, Poland, and Hungary, as part of a general policy of disengagement.

The Russian revolution is now 44 years old. For all Russians under 50, it is something they read about in history books. They are immensely proud of their new society, and completely confident that it will prove so superior to capitalism that first the awakening colonial peoples of Asia, Africa, and Latin America, and then the workers of the West, will turn to Communism, encouraged by the example of Soviet success, and fortified by the expectation of Soviet economic and technical aid. They dread war and are apprehensive of the growing danger of the arms race touching off a fatal accident. They are impatient of the ruinous cost of the arms race and the colossal economic waste of manpower and resources on defense. They want disarmament in order to go ahead still faster with expanding production, raising the standards of living and education, and shortening hours of labor. Of course, the fact that in the Soviet Union the public expression of news and views is officially controlled makes it more difficult to achieve mutual understanding, and it means too that the cleansing and corrective influence of a free public opinion does not operate within the U.S.S.R. The Soviet government can and does make mistakes, just like any other government. Soviet statesmen are human, like the rest of us—they are neither angels nor devils.

But the important fact is that the assumption on which Western policy rests, namely that the U.S.S.R. wants to impose Communism by force on other countries and can be restrained only by fear of Western arms, is sheer nonsense. It is the tribute paid by political illiteracy to social hysteria, the Great Illusion, the heartless hoax, the lie of the twentieth century. The military instruments of this policy are the interlocking alliances—NATO, CENTO, and SEATO. The bottom was knocked out of the assumption on which they rest—that the U.S.A. had a decisive superiority over the U.S.S.R. in nuclear weapons—when the Soviet Union overhauled and started outstripping the U.S.A. in this field. The claim that these military alliances are "collective security" is an abuse of language: the collective security system of the United

Nations is founded, as the Secretary General pointed out in his first Annual Report to the General Assembly, on the assumption that the permanent members of the Security Council, however much they might disagree or even deadlock on one or more issues of foreign policy, would acknowledge their common, supreme interest in averting the calamity of war, and, therefore, would not only go on trying to settle their differences by compromise and conciliation until they succeeded, but would be able and willing to work together through the Security Council to keep the peace. The military alliances, which line up the permanent members of the Security Council in rival war preparations through which they treat each other as potential enemies, wreck the collective system of the Charter and go back to the balance of power. To do that, they have erected the exception in Article 51 of the Charter—that a State may resort to arms without the authorization of the Security Council in defense against an armed attack—into the rule, stretched this rule to cover policies of armed counter-revolutionary intervention, and thereby reduced the rule of the Charter—that "threats to the peace, breaches of the peace, and acts of aggression" should be dealt with collectively through the Security Council—to a dead letter.

III

To claim that we can prevent war by preparing for instant annihilation is simply to embrace the exploded fallacy that "if you want peace, prepare for war," at the very moment when nuclear weapons have made this fallacy literally deadly. The so-called nuclear "deterrent" strategy is in fact a nuclear destruction strategy. So far from "preventing" war, it is guaranteed to precipitate war sooner or later, even when no one wants to fight. The argument that the fact that there has been no major war since the last one "proves" that NATO preserves peace, does not even rank as *post hoc ergo propter hoc.* It is more like the remark of one of the Gadarene swine to

another as they proceeded at a hand gallop toward the steep places: "Well anyway, this proves that the only way to keep from falling into the sea is to keep going." The talk about the members, clients, and dependents of the American-run military alliances being "the free world" is *Alice Through The Looking Glass* language. It stands reality on its head. President Kennedy reduced this talk to an absurdity when he announced he was going to Vienna to represent "the most revolutionary country on earth."

The official organ of the Vatican, the *Osservatore Romano*, as long ago as June, 1947, in four articles by its veteran editor, Count Guiseppe della Torre, analyzed the post-war world: just as 150 years ago, he said, a counter-revolutionary coalition led by Britain was arrayed against revolutionary France, so today there is a counter-revolutionary coalition led by the United States against revolutionary Russia. The basic object of this American-led counter-revolutionary coalition was described as follows by President Truman in his message to Congress of March, 1947: "There is one thing that the Americans value more than peace. It is freedom. Freedom of worship, freedom of speech, and freedom of enterprise. The pattern of trade which is most conducive to freedom of enterprise is one in which major decisions are made not by governments, but by private buyers and sellers. That pattern of trade which is least conducive to freedom of enterprise is one in which decisions are made by governments. . . . Unless we act and act decisively, it will be the pattern of the next century." The NEW YORK HERALD TRIBUNE summed up the burden of this message not inaccurately in its headline: "President says Americans love free enterprise more than peace."

President Kennedy has begun where Truman left off. He, too, talks of defending "freedom against Communism," when he means "free enterprise against Socialism," even if at the sacrifice of democracy and the risk of war. "America's attempt to export her formula of free enterprise democracy has met with almost unrelieved failure" wrote the NEW STATES-

MAN on May 19. "A skin of capitalism has been grafted onto a feudal framework, and this ugly and inefficient hybrid is kept alive only by constant injections of dollars and arms." Not only are these hybrid regimes ugly and inefficient. They are also so reactionary, tyrannical, corrupt, and unjust that they are incubating social revolution. "The events in Cuba and Laos" reports the TIMES Washington correspondent on May 19, "have persuaded the Administration not only that the post-war truce lines must be held, but that the peripheral areas must be kept, even in a semi-colonial status and with the force of American arms if necessary. . . . The earlier promise of elasticity, and with it a self-provided room for manoeuvre, seems to have gone and may well be replaced by something not unlike the old Dulles system."

On these lines American policy will not only be defeated piecemeal by popular risings against the intolerably reactionary and oppressive regimes the U. S. is paying and arming, but will alienate the Afro-Asians and other uncommitted nations. Worst of all, it will bring to a head the gathering revolt in the British people against American leadership and the policies of the cold war. This revolt came to the surface after the collapse of the Summit Conference. For a time the "image" of President Kennedy as a new Roosevelt pushed it down again. But the attack on Cuba, the President's justification of his aggression and lawlessness, and all that has happened since, have created the "image" of a technicolor Truman combining John Foster Dulles' policy of inverted Trotskyism or permanent counter-revolution with the cold war religion of Frank Buchman.

IV

The British people would gladly have followed an American leadership for ending the cold war and making peace. But they will not fall in behind a U. S. President who seems bent on stepping up the arms race and starting another round of the cold war. After the collapse of the Summit Conference,

British Gallup polls showed that (a) an overwhelming majority held the U.S.A. as well as the U.S.S.R. responsible for the fiasco; (b) whereas before the Summit only 19% believed the danger of war was serious, after the collapse the figure rose to 41%; (c) 85% did not believe our people could survive a nuclear attack; of the remainder most did not know and only a tiny minority believed we could engage in a nuclear war and live; (d) only one percent believed war was inevitable; (e) 64% thought it could be averted by non-military means, such as renewed negotiations with the Soviet government, a more conciliatory foreign policy, greater independence of the United States, and unilateral nuclear disarmament; and (f) only 10% believed the situation should be met by more armaments.

Other Gallup polls showed a clear majority against American bases in Britain. The Trades Union Congress in 1959 and the Labour Party Conference in 1960 voted for their removal. The Labour Party is already officially pledged to giving up the attempt to make Britain a nuclear power. It has worked out a foreign policy which looks to treating the Soviet Union and the People's Republic of China as partners in making and keeping the peace through the Security Council, on the basis of regional agreements implementing the obligations of the U.N. Charter. In Europe, Labour's policy calls for uniting Germany by stages, including at some point free elections, through the efforts of the Germans from East and West themselves and within an all-European framework of collective security, disarmament and disengagement, with appropriate controls, agreed upon and guaranteed by the four great powers.

In the Middle East, says Labour, the powers should give up the attempt to recruit allies, and should instead cooperate with each other and the Middle Eastern countries, through the United Nations, to control the traffic in arms, keep the peace, and provide economic and technical aid to underdeveloped territories. In the Far East, Labour's policy calls for admitting the People's Republic of China to her permanent

seat on the Security Council, as a preliminary to settling Far Eastern questions. These include the unification of Vietnam by means of free elections under international supervision, as provided in the 1954 Geneva Conference. Labour believes the same treatment should be applied for the unification of Korea, and that Chiang Kai Shek should be turned out of Tai-Wan and the island put under U.N. supervision while the inhabitants decide their future by plebiscite.

By and large, these policies are near enough to the known positions of the U.S.S.R. and the C.P.R. to make an agreed settlement by negotiation and future cooperation through the United Nations perfectly possible. Ultimately, they are rooted in Labour's belief, to which it has just re-pledged itself, that the spread of Socialism in the world is the only way to solve the first of the two problems with which we are confronted. It provides the necessary basis for the survival of democracy by ensuring its success in expanding production, raising standards of living and education, developing the social services, and banishing unemployment. From this follow the conclusions which Aneurin Bevan drew, namely, that the Soviet Union does not want war; Communism is a social challenge, not a military threat; and it is not Britain's business to fight Communism or put down revolutions in other people's countries.

These conclusions are endorsed by the overwhelming majority of the Labour Party, and far outside the ranks of Labour. At the same time, the realization is rapidly growing that the price Britain must pay for membership of NATO—and President Kennedy has done a lot to bring this home to our people—is to be a political satellite and a military base of the United States, which can compel us to abandon our own policies for making peace, on which we really could come to terms with the Soviet Union, and commit us to a war of annihilation for U. S. policies with which we disagree, over which we have no control, and which provide no possible basis for agreement with the Soviet Union and do not even recognize the People's Republic of China. Any

attempt, for instance, to involve Britain in little wars to "defend" the reactionary dictatorships the U.S.A. has imposed on Laos and South Vietnam, against the revolt of their own oppressed peoples, at the risk of touching off a world war, might increase the strain on the American alliance to breaking point. That is equally true of a war to keep the Shah of Persia on his shaky throne, or intervention on the side of reaction, corruption, and oppression in Turkey. If President Kennedy thinks he can count on British support for brinkmanship on behalf of the Adenauer government's obstinate refusal to accept any form of disengagement, or to recognize the existence of a second German State, or to agree to any change in what even President Eisenhower admitted was the "anomalous and dangerous" *status quo* in West Berlin, he is, I am afraid, going to be surprised—to say the least. In the British Labour Party in particular, awareness is growing of the fact that we are the military ally of a power whose purpose and policies are diametrically opposed to our own, against States we do not believe want to attack us or anyone else, and with which we could come to terms without much difficulty. Moreover, Britain's state of servitude in the American alliance is one which Labour is pledged to reject.

President Kennedy has made it clear that, as the State with more military power than all its allies combined, bases on their territories, supreme command of their forces, and a monopoly of the decisive weapons, the U.S.A. determines the purposes of the Western alliance and takes all the vital decisions. That could mean annihilation without representation for us in Britain. But at its 1952 conference, the Labour Party decided, and the National Executive Committee's resolution adopted at Conference the next year re-affirmed the decision, that "we can best serve the cause of peace by sticking to our distinctive Socialist principles and refusing to subordinate them to American, Russian, or any other pressures." At the same two conferences, the Party committed itself to condemn the policy of treating the risings of oppressed peoples as Soviet conspiracies and plots; supporting reactionary, anti-

working class forces anywhere; or using the military power accumulated by the Western alliance for defense to bring about changes of government or territory in other countries. These resolutions are practically a list of the objects being pursued by U. S. policy, which on disarmament, disengagement, political settlements in Europe, the Middle East, and the Far East, and East-West cooperation, is opposed to Labour's proposals on every issue.

V

The Left in the Labour Party has for some time been weaving these strands into the fabric of a tough, coherent, and realistic policy, to which it has been committing the Party piece-meal on some such lines as these:

1. Declare that in our view the arms race is kept going by mutual fear and suspicion, neither side wants to attack the other, and the more we get ready for instant war against the imaginary danger of aggression, the greater becomes the real danger of an incident provoking a fatal accident.

2. Therefore we reject the balance of power and take our stand on the Charter of the United Nations in relation to both the U.S.A. and the U.S.S.R. This means that the next Labour government will:

(a) renounce the manufacture or use of British nuclear weapons and remove all nuclear bases, supply or servicing depots, etc., from British territory;

(b) invite our principal allies and the Soviet Union to negotiate on Labour's proposals for disarmament and peaceful coexistence;

(c) make it clear that we should be prepared to negotiate with the Soviet Union even if our invitation were rejected by one or more of our allies, and would in that case bring any agreement so reached before the General Assembly of the United Nations, with a request that it be recommended as a basis of settlement;

(d) draw the attention of our allies to the fact that the *casus foederis* in NATO, CENTO, and SEATO is "unprovoked aggression," that is, that Britain's collective defense obligations under these treaties become operative only on behalf of States which the British government consider have been subjected to "unprovoked aggression"; and,

(e) serve notice that any ally who refuses to negotiate on our proposals and continues to pursue policies we regard as provocative and dangerous, will not be regarded by us as a victim of "unprovoked aggression" if he becomes involved in a conflict.

These measures would give a Labour government the bargaining power necessary to bring both sides together on its proposals for peace. The Soviet government would agree to negotiate on them once it was convinced we meant business and would not regard an American refusal as disposing of the matter. The U. S. Administration and our European allies would be under strong and cumulative pressure from their own public opinion and from the uncommitted nations to negotiate. Moreover, they would know that if they refused, the alliances would become a dead letter so far as Britain was concerned.

We would persist. We would not take no for an answer. We would appeal to the peoples over the heads of their governments. And we should be upborne by the conviction that we had gauged the realities and needs of the situation correctly, and that in the context of disarmament and peaceful coexistence there would arise an economic necessity and political demand for bigger and better New Deals in the United States and more Socialism in Western Europe—but also for more democracy and political freedom in the East. For Communism is not something fixed and unchangeable. The successes of the Socialist States are producing complex industrial societies and educated populations which cannot function successfully without the right to speak their minds, have access to information, exchange views, and take decisions. The main thing holding men back now is the cold war, which is the

ally of the police state and the enemy of democracy and freedom everywhere.

If we really believe enough in our own ideas not to be afraid of those of other people, and have enough confidence in democracy and freedom to disbelieve in interfering in the internal affairs of other countries, the end of the cold war is in sight and peace will dawn on earth.

THE IRONY OF THE BOMB

William Appleman Williams

THE AGE OF THE ATOM has so far been an Era of The Bombs. While this is not surprising (since all birth involves violence), it is nevertheless exceedingly misleading and uniquely dangerous. Prolonged beyond its due, any birth trauma destroys the life it offers, and this is particularly true with nuclear fission and fusion. The dramatic and deadly characteristics have distracted Americans from basic issues and dilemmas which will in the end determine the length and the nature of the age itself. As Sir Charles P. Snow has put it, the scientific gadget may induce a social and philosophical euphoria that will put us all to sleep. The real horror of the hour lies in the possibility that we are dropping off into a sleep in which we will again use the bomb.

The bomb *is* a gadget, and does not in and of itself change anything but the ease and efficiency with which we are enabled to go about our business. The crucial issue is whether or not we shall get straight on what our business is, and then evolve the relevant attitudes and means for its conduct. Hence the real meaning of the bomb—and of the age itself—is to be found in three traditional, even trite, issues: the narrow or immediate question of strategic military security; the nature and dynamic of the *Weltanschauung*, or conception of the world, we use to guide us; and the kind of institutions we build to implement those ideas and ideals. An examination of these three areas suggests rather strongly, and again in an old-fashioned way, that strategic military security is fundamentally dependent upon our ideas and our domestic institutions.

I

Despite all the huffing and puffing about the missile gap (and related examples), the incontrovertible strategic fact is a

very simple one: the United States has sufficient nuclear power and the capacity to deliver it on target. As military leaders have been embarrassingly overfond of announcing during the last 15 years, the over-kill rating of the American arsenal is literally awful. This does not put us back into the past and again reduce everything to four continent infantry and seven ocean navies. The various arguments that such is the case are all compounded of a very sophisticated and wishful naiveté. Both sides will use nuclear weapons when and if they go to war. The bomb does two quite different things: it offers an opportunity to reduce military strategy to its essentials, and thereby to clear our minds for coping with fundamental social and philosophical problems.

Though the original monopoly of nuclear weapons held by the United States has been reduced to parity, the change has not created a situation in which strategic security hinges upon the discovery of some new gadget. Yet in all the excitement over the neutron bomb, there is manifested a determined refusal to admit this elementary fact. The implicit assumption that an enemy would, if confronted with defeat, refrain from using bombs producing extensive radiation (or that the United States would) is matched in its fantasy only by the implied argument that it is somehow more moral to use a weapon which only kills hundreds of thousands of human beings at the scene while leaving property undamaged. And since official American policy has always discounted the effect of radiation, it is even amusing in a mawkish way to hear the proponents of the neutron bomb defend it on that particular point. The heart of the matter is that in both the production and delivery of devastation we have reached a new plateau, and strategy will be conducted on that plain for an indefinite period. It is ridiculous to talk seriously about going to the moon to shoot at the earth. The idea violates even the most rudimentary rules of the lowest common-denominator kind of common sense. Such pseudo-thought should not be dignified even by calling it childish—it is simply lunacy.

But such nonsense has been taken all too seriously for more than a decade, and as a result the United States is only belatedly beginning to recognize the nature of—let alone explore the implications of—the primary technological fact affecting basic strategy. It is very simple: *The United States can now be defended from its continental limits.* Striking though it may at first appear, this fact (which is so subversive of most contemporary American thinking about foreign affairs) is not as revolutionary as it generally seems to be to those who have matured since the 1920s. For it was also true—*and was recognized as such*—during the period which began at least as early as the end of the War of 1812 and lasted well into the 1890s. And for that matter, the central logic of Washington's Farewell Address turns upon the General's clear perception of the same truth. Furthermore, it remained true in fact long after the 1890s, but American leaders began in that decade to *think* that it did not. The war with Spain and American entry into World War I offer appropriate dates for marking the policy triumph of that thought.

Now to recognize and state in such blunt terms the fact that the United States can now be defended from its continental limits is to open oneself to the charge of trying to disguise the virus of isolationism (or appeasement) as the antibody of realism. Although the accusation has in recent years become little more than a cliché of disapproval and an excuse for thought, not even its original (and more substantial) content is any longer relevant. The issue raised is not one of withdrawing into an air-conditioned Fortress America and living off a closed circuit culture. It is instead the very philosophical and practical question of how best to exploit this technological fact for the wealth and welfare of the United States and the rest of the world.

II

Long generations before Frederick Jackson Turner was even born, Americans were talking about the safety-valve function

of more Western land (and related resources), and acting on their idea that such expansion not only produced more wealth, welfare, and democracy than any other method, but did so in a more moral as well as an easier manner. Turner and his successors (some of whom criticized him in arguments reminiscent of scholastic disputes at their picayune best) merely restated that ancient idea in the context of industrialization and urbanization. It was a competent—even professional—job of reformulation, but one is sometimes tempted to conclude that the reason it created such a stir among historians was because they were so unfamiliar with the thought of Madison, Jefferson, Jackson, Polk, Lincoln, and Seward.

Though periodically challenged since the 1890s by such men as Charles Austin Beard and a small segment of the Progressive Movement, that outlook has defined the American *Weltanschauung* throughout the 20th Century. As a result, both evil and opportunity have been externalized to an extensive degree. For roughly half-a-century, Germany and Japan were viewed as twin agents of the devil while China was seen as the new frontier. Then, in an almost predictable *volte-face,* China and Russia became evil while Germany was redefined as a partner in developing the new frontiers of India and Africa, and Japan became an outpost of the Metropolis in Asia.

During the entire period, Latin America has suffered from, and endured the consequences of, an ambivalence in the thinking of the United States. On the one hand, Washington policy-makers and their business allies have clearly considered the area as an integral part of the new frontier; and they have penetrated and developed it in some respects. On the other hand, Latin America has often been taken rather much for granted while leaders of the United States concerned themselves more vigorously with establishing quit claims in other regions and in competing with their industrialized rivals. As a result, Latin America has been treated as a chronically dependent relative who was always on hand for odd jobs, yet who was seldom dealt with even as a full (though inferior)

member of the community. Not too surprisingly, therefore, it has been the experience of having these assumptions and attitudes toward Latin America seriously shaken into question that seems to have accentuated other doubts about the entire frontier *Weltanschauung.*

Along with the patent concern over the significance and influence of Castro's Cuba, such events suggest that subversive ideas are being almost literally forced into the consciousness of American leaders. However haltingly, for example, there has been developing a belated and tenuous recognition of the fact that overseas bases are not only troublesome politically, but are actually very risky and even unnecessary in the narrow military sense. Even more noticeable, perhaps, is a realization that American aid is subject to diminishing returns in direct proportion to the degree that it is given with the idea and for the purpose of creating outposts of American society.

Probably the most accurately indeterminate bit of evidence lies in the reaction to President John F. Kennedy's proposal for a crash program to populate the moon with New Frontiersmen. A significant body of opinion seemed to realize that, while going to the moon is neither bad nor unimportant *per se,* the adventure is neither the most immediately relevant and pragmatically effective policy to pursue nor the most significant way to define America's role or purpose for the second half of the 20th Century. Yet in the end, and while repeating most of the traditional rhetoric about defending and extending the frontiers of freedom, the project was approved by the Congress.

Whatever the momentary balance on a tally sheet of such episodes, the criticism and debate indicates an awakening to the fact that the concepts of isolationism and internationalism are irrelevant to the real issues. They becloud and confuse our thinking and our policies. If we can come to terms with that intellectual fact, it may be possible to discuss the basic problems without touching off the usual outburst of irrationality and invective. The central meaning of the Age of the Atom is that America's traditional frontier outlook,

which defines America's security and welfare as being dependent upon external factors, is no longer tenable. As Turner himself admitted, the frontier outlook (and policy) has provided a "gate of escape" through which Americans have tried (with considerable success) to evade the moral axiom that evil cannot be externalized, and to ignore the practical rule of thumb that we ourselves bear a primary responsibility for what we make of our resources. In that connection, it would be illuminating of the entire *Weltanschauung* to discover how many people who blame outsiders for our troubles would also be willing to follow that logic and credit the devil with his full share of commendation for the rewards that have accrued from mobilizing to thwart him.

III

But the point is not to make ourselves squirm for the masochism of it. It is rather to clarify our confusions and remove them. Hence the place to begin is with the unfavorable image of isolationism; for hidden behind that infamous stereotype lay some neglected verities that are essential to any improvement in our present policies. Now it is of course true that no man (or nation) is an island. But that striking aphorism has so monopolized our attention that we have lost sight of the equally vital truth that ceasing to be an island does not mean that a man (or nation) must become part of everything in the world.

Yet that is the precise way in which the so-called internationalists have in practice defined the alternative to a Fortress America. The logical and in this case historical outcome of that attitude was the grandiose conception of The American Century that was so ecstatically embraced by the internationalists (liberal and conservative alike) shortly after the outbreak of World War II. But the inveterate meddler is as psychopathic as the hermit. He is also a tyrant of the most insidious type. For where he does not actually take charge of the affairs of others, he redefines and restructures the situa-

tion in a distracting way and according to irrelevant criteria.

Furthermore, and it is of considerably more than merely historical interest, the great majority of so-called isolationists never advocated anything remotely resembling the fantasy that the internationalists created as the public version of a Fortress America. At the heart of the isolationist vision was a conception of the Western Hemisphere as an integrated American System not at all unlike the ideal of many 18th and early 19th Century leaders. To put it kindly, they saw a sizable empire evolving toward a voluntary commonwealth subtly but effectively dominated by the United States. Only by comparison with the internationalists could the isolationists be called Little Americans. All special pleading and adolescent nationalism aside, the western hemisphere is an empire-sized bite for any nation—past or present. Secondly, all of the isolationists assumed and expected that this hemispheric empire would carry on extensive economic and cultural intercourse with the rest of the world. Not only was humanitarian assistance to the less fortunate countries within and without the empire viewed as part of such relationships, but the isolationists were by no means so naive as to think that political involvement and conflict could be avoided.

Instead, and thirdly, they argued that the extension of politics into war should be undertaken only with great reluctance and only when it was clear far beyond an internationalist's rhetoric that the hemispheric system was threatened. And it is often and conveniently forgotten that the majority of inter-war isolationists had reached the conclusion that it was so threatened *before* the attack on Pearl Harbor. Finally, the isolationists laid great stress on the crucial importance of honoring the practice as well as the rhetoric of representative government in the making and the conduct of foreign policy. The routine dynamics of intra-governmental and party politics surely played a part in that argument, but the isolationist critique can not be dismissed on that ground. Perhaps now, twenty years later, when routine bi-partisanship and policy-making behind closed doors have become blatant

realities which worry a good many Americans, it would be possible to admit that the isolationists had a very fundamental point.

In summary, then, the isolationists argued that the bed rock purpose and responsibility of a society involved transforming a social system into a true community, and that its humane and practical obligations to, and intercourse with, the rest of the world would be honored and fulfilled in direct proportion to its success in that eternal quest. As a result, they insisted that physical survival (and hence military strategy) was a means that should not be invoked to justify or excuse every propensity to stray from the ideal.

To avoid confusing the most important issue in this broad inquiry, let it be admitted in concluding this subsidiary discussion of the isolationist-internationalist conflict that the isolationists were tardy in recognizing the military threat as it developed after 1939. Having granted that, it still remains true that the isolationist's insight can be ignored or discounted only at grave peril to ourselves—and to others. In acting on the foreign policy implications of the truth that no man is an island, one can not and should not try therefore to become part of everything. A great many very practical benefits flow from such an ability to separate the past from the eternal.

IV

One is an understanding that an acceptance of diversity is the key to a morally defensible and a pragmatically effective diplomacy. This is so at any time, but especially in an age of revolution. It is moral because other societies do have an elementary and extensive right to pursue their own objectives in accordance with their own traditions and ideas. Once this is not merely acknowledged conversationally but accepted as an axiom of thought and action, then it becomes possible to come to terms with the otherwise frustrating verity that American aid can at most play a limited role in the develop-

ment of other societies. It can neither fundamentally foreshorten the time required, function as a substitute for the commitment required of the foreign society itself, nor dispell all the pain and sacrifices involved. Development is not a sophisticated exercise in mathematical economics, or the product of exhortations to rise against the devil: it is a hard, difficult, and wrenching experience in the creation of an economic foundation and a community will and spirit of purposeful sacrifice.

For those reasons, it is immoral *and* foolish (not merely, as a good many American leaders seem prone to think, immoral *because* it is foolish) to expect aid to create either reasonable facsimilies of the United States or voting machines for the approval of American foreign policy. Neither a person nor a nation can function dynamically if its existence is defined as a shadow. One American foreign service officer recently offered testimony as to the way in which events—if nothing else—are forcing the United States to confront this very mundane psychological and practical reality. Speaking of Brazil's recent and vigorous assertion of its determination to play its own hand at home and abroad, the official's remarks also revealed how slowly the old attitudes give way. "We may not like the fact that Brazil has adopted what President Quadros describes as an independent foreign policy and what we might describe as a neutralist one. We must consider the measures we contemplate from the viewpoint of whether they will tend to make Brazil independent and whether they will tend to make Brazil democratic and friendly."

Yet however painful it is, or becomes, we must go further than that. We must have both the courage and the confidence to let other people make their own mistakes, and we must extend that tiny clearing of tolerance toward a big nation like Brazil to include small, weak countries. We must also begin very quickly to do it voluntarily. This habit of learning by doing—*ala* our handling of Cuba—is not only fundamentally anti-intellectual, but it gets more dangerous each time we touch a revolution to find out if it is really hot.

Finally, and from all such episodes, there emerges one rather obvious (and certainly not new) idea: the most moral and the most practical strategy (and tactic) of foreign aid is to channel such assistance through the United Nations.

For only in that way can the critical commitment required of the developing country—and its rising self-consciousness—be separated from the short-run objectives and day-to-day conduct of American foreign policy. Indeed, the developing countries need for their own maturity to give up the convenient scapegoat provided by the United States just about as much as America needs to abandon its own whipping boy in the form of the Soviet Union. Consider, for example, how much easier it would have been to deal with the Israeli-Arab dispute if both the Aswan Dam project and the nationalization of the Suez Canal had been handled through the developmental agencies of the United Nations.

In an even more direct way, such a turn toward the United Nations might very well help the United States evolve a less childish and possessive approach toward the nationalization of American assets by the developing societies. Such countries very much need the economic and psychological capital provided by nationalization, and the United States is in reality engaging in the truly subversive policy of cutting off its nose to spite its face when it remains adamant on the issue. After all, there is very little justification for the people of the United States to pay the price of a serious crisis just to lecture the Cubans about the sin of taking property that belongs to a tiny segment of the American population. Common sense as well as statesmanship in such cases is defined by offering a plan that permits nationalization and ties it to a broad gauged plan for accelerating and regularizing regional economic development. Here again the technique or policy is relatively simple to work out: it is the change in attitude that is so difficult and yet so crucial to effect.

At this point the isolationists offer a second vital insight. For it seems very likely that the only way to cut through to the heart of the foreign policy dilemma is by slashing down

to the roots of domestic affairs. Here the underlying necessity is to confront boldly and imaginatively the extensive role played by the national government in the American political economy. Appropriately enough, the production of the bomb dramatizes the extent to which the government functions as an accumulator and allocator of capital, and even as an entrepreneur in the more traditional and explicit sense. And just the acceptance of this elementary fact of American reality immediately provides a magnificent vista into foreign policy. For if Americans better understood this domestic truth, then they would very probably show in foreign affairs considerably more understanding of and toward the role of government in the developing countries. To be somewhat facetious, even Herbert Hoover saw the need to nationalize the production of large dams. But the central issue, far too long neglected, concerns how to deal with this role of the government in its institutional and political phases as well as in its economic aspects.

Since the government accounts for roughly one-third of the Gross National Product, it is both silly to ignore the fact and dangerous to continue the *ad hoc*, creeping kind of syndicalist state capitalism that it has produced and goes right on consolidating and extending. One direct result can be seen in the kind of pseudo-conservatism advocated by Senator Barry Goldwater and the even more extreme reaction of the John Birchers. Those leaders (and their supporters) are as much the product of the lack of any relevant conservatism or liberalism as they are of the reality itself. What is needed is not a debate about how, and how far back, to go into the past, but rather a very serious, probing discussion of how to use the state for mature, consciously formulated purposes and how to reinvigorate and institutionalize democratic procedures for reaching and implementing those kinds of decisions.

The ideas and ideals that would emerge from that kind of national seminar—something quite drastically different from the recent scholastic quibble about National Purpose—would in turn be the most effective kind of foreign aid ever devised.

Indeed, that is precisely the kind of foreign assistance that the Soviet Union has been offering with such telling results for the past generation. To be sure, Russia's monetary grants are impressive because of the fantastically higher relative sacrifice they represent, and because they are allocated in a sophisticated way to coincide with the aspirations of the developing countries. But the crucial Soviet exports never appear on an economic bar graph. They are the confident assumption that development is possible in a generation, and a model and example of how to accumulate and allocate capital for that purpose.

In its own ironic way, therefore, the production and use of the bomb—a violent instrument of the internationalist *Weltanschauung* in foreign affairs—has created the necessity of revising the outlook which led to that action, and of evolving new ideas and instruments for domestic affairs. The history of the Age of the Atom will very largely turn upon the extent to which the United States masters its fears and coordinates its will and its intelligence in coping with those challenges. For while a war is not inevitable, it is as certain as things can be in human affairs that a nostalgia for the past finally produces a false and thereby deadly euphoria about the present and the future.

THE FUNDAMENTAL ISSUES OF THE NUCLEAR AGE

CHARLES C. PRICE

THE PURPOSE OF THIS ESSAY is to stress the concept that the basic motivating force of our domestic and foreign policy should be to provide the material essentials for human life and to promote the ideal of respect for human liberty and dignity. The enormous destructive power of nuclear weapons has rendered national military force a threat against these basic human goals, not, as has sometimes been the case, an instrument to promote them. The increase in interdependence consequent on technological development demands continuous change in our institutions to meet these basic human needs. To serve as an effective political instrument for peaceful change, the United Nations must be developed from a useful forum for international political debate to become also a responsible legal institution able to cope with the major problems of the community of nations. By making the United Nations an effective political institution, we can then pursue our objectives through it, instead of relying so heavily on dangerous, obsolete, and extravagant national military measures.

I. Basic Principles and Physical Change

The expanding realm of technological development has thrust the world into an era which may well prove to be the most revolutionary in the brief, hectic span of man's historic existence on this planet. We grow almost numb from crisis upon crisis; the welter of issues and strife is bewildering and confusing to all!

Is the main issue colonialism? Communism vs. capitalism? War vs. peace? Military strategy? Nationalism or world government? "Arms control" or disarmament? Nuclear testing?

The "population explosion"? The "haves" vs. the "have nots," "Freedom" vs. "totalitarianism," world economic development? Race relations? The effort to see a simple, sensible, safe path through these frequently conflicting, contradictory, confusing, and complicated issues is so difficult as to discourage even the most optimistic.

In my own field of science, it is frequently immensely helpful to look at a conglomeration of experimental facts, sometimes just as baffling and confusing in their way, to see whether unifying fundamental principles can be recognized and formulated. These have frequently permitted the whole array of facts to be transformed from a babble of incoherent, isolated, unintelligible bits and pieces into a comprehensive, organized pattern. Such formulations of hypotheses, principles, and laws of nature not only offer the satisfaction of giving us comprehensible insight into known areas, but frequently provide the basis for dramatic and revolutionary projections into wholly unsuspected new fields of endeavor.

Perhaps the spark needed to organize the immensely dangerous riddles, issues, and challenges of the nuclear age is to penetrate through the clutter of outmoded ideas and emotions to see whether fundamental principles can be discerned. If so, then perhaps these can be used to judge the validity and significance of existing institutions and practices and to point the way toward the future.

From the viewpoint of the individual human being, the "fundamental particle" of society, his first need is to meet the physical necessities of *life*. He must have food, clothing, shelter. He should be able to cope with the challenge of disease, starvation, and bodily assault. Having met the prime requisites of life itself, the second basic characteristic of the human being is his strong urge for individual liberty, for being free of the dictates of his fellow men in seeking to satisfy his role in life. These properties are the fundamental principles governing the basic units of societies. They were recognized in the Declaration of Independence in the words: "We hold these truths to be self-evident, that all men are

created equal and are endowed by their Creator with certain inalienable rights, that among these are life, liberty, and the pursuit of happiness." The Declaration then continued: "That to secure these rights, Governments are instituted among men, deriving their just powers from the consent of the governed, that whenever any form of Government becomes destructive of these ends, it is the right of the people to alter or abolish it, and to institute new government, laying its foundation on such principles and organizing its powers in such form as to them shall seem most likely to effect their Safety and Happiness."

In these words, Thomas Jefferson stated the fundamental aspirations and characteristics of the human individual and recognized that human institutions should be molded to protect and promote these basic needs. Are these concepts valid today? How do they apply to a world in the throes of, not one, but several concurrent revolutionary changes?

II. The Revolution in Weapons

The first revolution to consider is that in military power and technology. The combination of nuclear weapons, nuclear submarines, and intercontinental missiles has so changed the nature of war as to render obsolete the concept of defense of national territory by national military power. I do not understand how a sane man can any longer consider that constructive national goals can or should be achieved by use of such weapons. How can the United States, founded on the principle of the dignity and worth of the individual, continue to base its national policy on the principle that we must make credible to any potential enemy our intention and ability to exterminate hundreds of millions of their citizens? How have we been led into this fantastic contradiction? Have we so enshrined the military institution that it has become a Frankenstein monster which can completely destroy us?

While the Soviet Union is making repeated proposals for general and complete disarmament, for the elimination of all

national military establishments, why is the United States so unwilling to discuss this question seriously? When nuclear war offers such a colossal threat to "life, liberty, and the pursuit of happiness," why do we spend $40,000,000,000 every year for arms, but almost nothing on planning for peace? It is my belief that the American people, through a combination of military propaganda, money, and Madison Avenue techniques, have been sold the idea that we can "defend" our principles only by military force and violence. The military budget has been used to finance all kinds of studies of "military gaming" and of study sessions and conferences to "sell" opinion leaders on the needs of a policy based on nuclear deterrents. In part because of the dramatic and complex power of modern military weapons, we have become mesmerized by the military threat and, like the moth and the flame, may well be lured to our destruction.

In his final address as President, Dwight D. Eisenhower warned of the danger of the "military-industrial-scientific complex," which draws its life-blood from the ability to convince American citizens of the importance of military "defense." Many Americans who work for and support this complex have convinced themselves that only by having the ability to exterminate our enemies may we be able to deter an attack on the United States.

In seeking the solution to the dilemma of nuclear weapons, we must look carefully at the basic principles as expressed in the Declaration of Independence. Is the American policy of nuclear terror based on preserving the military institution, on enhancing the political power of the United States Government, or on preserving the idea of individual liberty and the value of human life? Certainly, the latter is the fundamental objective we seek. The question, therefore, must be: is our present military policy apt to preserve and promote this idea—or will it ultimately destroy these principles?

III. Political vs. Military Objectives

We have been gravely deluded in this country by the idea that we need to meet the Communist threat mainly by military force. The big danger from our preoccupation with the military threat—our capitulation to the military interpretation of our grave problems—is that we fail to see the immense political and economic challenges and opportunities before us as a result of the "revolution of rising expectations." Many great Americans throughout our history have recognized that the basic idea of the American revolution—the subservience of human institutions to the idea of the basic human rights to life, liberty, and pursuit of happiness—could become the pattern for all of humanity. As the technological breakthrough comes to more of the world's people, meeting their primary preoccupation with the physical needs of life, the urge for political liberty and a better life will spread rapidly.

One great challenge before us is to find ways to encourage the political and economic development of these peoples. Their hopes and aspirations should not become pawns in the power struggle between the East and the West. The overriding interests and welfare of the international community of nations must be recognized and given substance in such a way as to minimize the hazards of violent solutions and, particularly, of nuclear war.

Our deep commitment to the nuclear arms race has forced us time and again to take positions on the crucial political and economic phases of the cold war contrary to fundamental human values. We have, on sad occasions, placed the military considerations of NATO ahead of the aspirations of the colonial peoples to emulate our struggle for political independence. We have repeatedly stated we could not contribute to more effective economic development programs because of the expense of our military program. Since meeting the material needs of life and achieving political independence from outside domination of their local affairs is the fundamental driving force and basic aspiration of human societies,

we thus permit our military dictates, based on obsolete concepts of the place of national military power, to place us athwart the major revolutionary thrust of the nuclear age.

The basic concept of society implied in our Declaration of Independence is that the authority of organized institutions should be limited to that which is necessary to promote "life, liberty, and the pursuit of happiness." This should apply to corporations, to labor unions, and to governmental units. The functions of these institutions should be either to provide those needs for life or happiness which require joint action, or to protect the individuals from undue impositions on their liberty by others. The whole philosophy of the military, except for its now obsolete function of defending our nation from attack, is contrary to these concepts. It seeks, by force of arms if necessary, to impose the will of one government on another. Too many of those supporting our military policy today are wedded to this idea of using our power to dictate the policies of others. We should, instead, accept the philosophy and seek a system of organizing society so that the need of one individual (or group) to bow to the dictates of another is minimized. At the local level, we organize local governments for this purpose, with adequate power to protect the liberty and promote the welfare of its citizens. The revolution in military weapons, in communication, and in interdependence demands that the United Nations become this kind of instrument for the international community. The price of liberty on all levels, personal and national, is the acceptance of responsibility for organizing and supporting the political institutions which make liberty possible—and thereafter eternal vigilance against those who would pervert these political institutions for personal or selfish, as opposed to community, purposes.

IV. What of Disarmament?

Because of the obvious threat of major destruction to life and property posed by nuclear weapons, the normal reaction of

most people around the world is, "ban the bomb." An immense amount of talk during the past dozen years has centered around efforts to regulate and control weapons. There has been general acceptance by all sides of the need for "inspection" in connection with any agreements to limit arms. The common impression held by most Americans, and one fostered greatly by American propaganda, is that the major obstacle to arms control is Russian obstruction of adequate means of inspection. This is today a considerable misrepresentation. In the disarmament discussions, the essence of the positions of the two antagonists has, in fact, been that the United States wanted extensive inspection with very little disarmament, while the U.S.S.R. wanted extensive disarmament with very little inspection. The public has been led to believe that the real problems center on the complex technical aspects related to inspection—with the result of confusing the American people on the real problems involved. The regrettable fact is that, in spite of many speeches which may have been made to the contrary, the United States has not yet accepted "general and complete disarmament" as a working goal for American policy. Evidence for this fact is the mere handful of people assigned any responsibility for disarmament in our government—and most of them have been devoted to schemes for arms control, rather than real disarmament. Until recently, even these modest efforts were resisted by the Pentagon and the Atomic Energy Commission.

It is important here to stress the fundamental difference between "arms control" and disarmament. The former is designed with the hope of stabilizing the arms race. Its objectives are no different from the naval agreements of the 1920 era. It is based on the continuation of military force as the cornerstone of national foreign policy, as the ultimate arbiter of international disputes, and as the principal means of projecting the national will. It is my conviction that policies aimed at arms control are as doomed to failure now as they were in the 1920s. The only major difference will be the size of the ensuing catastrophe.

The basic fallacy of the American "arms control" policy is its utter failure to realize that atomic weapons have made it imperative not merely to limit but completely to eliminate the military and war as a component of civilized society. Since national military organizations now have no real purpose other than to oppose and "deter" each other, why not take the sensible course of eliminating them as an extravagant expense and an evil threat? Their expense is an unnecessary diversion of resources from meeting human needs. Their destructive power is an ignoble, immoral, and insane threat to the sanctity of human life. The function of deterring aggression could be performed far more safely, effectively, and economically by a United Nations Police Force in a disarmed world.

The nature of the operation which has been used to misinform the American people on the disarmament issue is complex and clever. It is undoubtedly compounded from a variety of factors and exploits a number of techniques: it makes use of such genuine concerns as the evils of Red slavery, the duplicity of Communist methods, fear of the economic impact of disarmament, and the emotional appeal to nationalistic instincts. While these all have some justifiable basis, they do not seem to me to support our rejection of serious negotiation of general and complete disarmament. This goal was proposed officially by Great Britain and the Soviet Union at the United Nations in September 1959, and was endorsed as the most urgent problem facing mankind by unanimous vote of all United Nations members. Khrushchev has stated he would be willing to consider any controls we want if we would accept the goal of complete disarmament. I certainly do not pretend to know whether he means what he says, but I am ashamed of my government when it can only call him a "liar" because we have *no* carefully considered proposals for a disarmed world to present for negotiation.

I regret that one of the reasons for this failure may be the deplorable, defeatist view that we could not compete effectively with the Communist world on the political and eco-

nomic level and, therefore, we must remain prepared to deal with them on a military basis. This would be a tragically twisted view of our situation and our opportunity. By diverting our attention from the potentially constructive arena of international political and economic competition to the evil, bitter, and destructive competition of the arms race, this military view of the world in revolution is handcuffing our policy in the areas where American leadership and initiative could be decisive.

It is absolutely essential for the survival of life and liberty that we somehow break the stranglehold of military considerations on American foreign policy. If the objectives of life and liberty can be best promoted by elimination of all national military institutions under a United Nations with effective and safeguarded political and legal authority for the purpose, then we must not let the self-interests of the $40,000,000,000 a year military-industrial-scientific complex obstruct American initiative and leadership in this direction. We must not let survival of an institution, even one as immense as the American military, become more important than the survival of the principles of human life and liberty it was once able to protect.

It is indeed a myopic view of the greatness of our principles, the vigor of our political institutions, and the intelligence and dedication of Americans to feel we could not cope successfully with the political and economic challenge of the Communists in a disarmed world!

If we—and the Communists—were willing to agree to the basic principle of political and economic competition in a disarmed world, providing only that there be adequate international organization to prevent any state from forcibly interfering with the affairs of others, then I believe the details could be satisfactorily worked out.

The crucial decision of the nuclear age thus becomes that of deciding to abandon national military power as the ultimate arbiter in international affairs and to replace this by effective political and legal institutions. In short, we must

make the United Nations into an effective world federal government so that we may have "a new world of law, where the strong are just and the weak secure."

It should be made clear that this will no more settle the political problems that divide the world than our own federal government has settled such controversial problems as race relations, medical aid, and labor union responsibility. It will only lay the ground rules and set the stage for working for the political accord which will enable such problems to be settled eventually with a minimum of violence and strife.

V. World Peace Through World Law

"World peace through world law" thus becomes a central issue of our time. Harvard University Press has published a monumental book with this title, written by Grenville Clark and Louis Sohn. This book proposes a detailed, carefully analyzed, article-by-article revision of the United Nations Charter to accomplish the general purpose of transforming the United Nations into a responsible political and legal instrument to maintain order and provide for peaceful change in a disarmed world. It calls for a United Nations armed force, with all nations stripped of major aggressive weapons, but permitted to retain specified levels of militia sufficient for internal police functions. This book has been published in several languages and has had world-wide distribution. United Nations Ambassador Adlai Stevenson delivered a copy to Khrushchev in 1958. Whether this has in any way influenced Khrushchev to advocate a disarmed world with a United Nations force to maintain order is pure conjecture.

In the last Congress of the United States, there were two measures closely related to this issue. One was a resolution calling for strengthening the United Nations into an instrument of enforceable international law, urging our government to undertake serious study of the issues involved, and asking that other governments do likewise. President Kennedy was one of twenty-six sponsors of this resolution.

The other resolution called for rescinding the Connally reservation on our adherence to the World Court. The statute of the Court specifically forbids it to assume jurisdiction over any domestic matter, thus restricting it to international disputes. The Connally reservation sets the United States up as sole judge of this matter of domesticity and thus, in effect, sets us above the jurisdiction of the Court. Repeal of the Connally reservation has the support of Former President Eisenhower, President Kennedy, Former Vice-President Nixon, and both the Democratic and Republican 1960 national platforms. It is not a big step, in practical terms, in developing international law, but failure to repeal serves notice of our continued domination by those whose thinking is opposed to the concept of replacing the law of force by the force of law in international affairs.

I hope it is obvious to even the most optimistic that the achievement of the goals outlined above as necessary to meet the challenge of the nuclear age will be neither quick nor easy. It seems equally clear that progress will be made at all only as the result of continued, determined effort by those who see and understand the urgent need to eliminate international war—before it eliminates us. The struggle in this direction is unlikely to be marked by clear milestones. The League of Nations, the United Nations Charter, Korea, Suez, the Congo have undoubtedly all been steps. Who can say when we will have crossed the threshold to a world of order where war and organized killing of human beings will have become as remote and unlikely as eating human beings? Certainly the goal is worthy of our best efforts.

SCIENCE AND FEAR—A DISCUSSION OF SOME FRUITS OF SCIENTIFIC UNDERSTANDING

Frank Oppenheimer

AN ENORMOUS EFFORT is currently being devoted to science, and it is therefore certainly appropriate to analyze and even extrapolate the possible fruits of scientific understanding. It is clear that scientific progress can relieve much of human misery and can extend the group of people who partake of the general culture. It can reduce the backbreaking and spirit-killing labor which, even now, is the fare of a large section of humanity. On the other hand, scientific progress appears to increase our insecurities by putting new tools of destruction and subjugation and regimentation at man's disposal.

In addition to these well-recognized effects, the explanations of science interact with the way in which we think about the world and about ourselves, and frequently either reinforce or modify the general philosophical and moral thinking. Many attempts have been made to determine the effects of scientific understanding on non-scientific thought and attitudes. The ideas of physical complementarity imply the impossibility of devising an intuitive model which simultaneously describes all known properties of an electron, or, alternatively, of conceiving an experiment which would simultaneously measure these properties. These ideas of quantum mechanics have been shown to have their counterpart in the human difficulty of making a mental image of ourselves which includes, for example, both the unique importance of life and its resemblance to ashes and dust. Certainly in this case, quantum mechanics neither gave rise to nor solved the analogous ethical problem. On the other hand, the insights gained about atomic physics enable me, and I believe many other people, to be more relaxed about this philosophical paradox.

There is the somewhat analogous interaction between the ideas of relativity and the realization that very different cultures and even different moods of the individual may be expressions of the same human qualities. Certainly the ideas of special relativity have no direct relevancy whatsoever to the social problem. Nevertheless, the fact that in physics one can keep certain conceptual quantities invariant and still pass, in a logical (and mathematical) way, from the description of an event in one frame of reference to a very different description in another frame of reference has made some of the ideas of cultural and psychological relativity both more acceptable and more plausible.

I plan to discuss primarily another effect of science on our thinking, that is, its effect on our worries and our fears. My motive for considering this aspect of science is simple. At the moment people all over the world are preoccupied either with acquiring a share or with keeping their share of the benefits of the industrial revolution. Although all manner of natural disasters, earthquakes and famines and epidemics, could thwart this purpose, the most dreaded phenomena, for Americans and Cubans and Congolese alike, result from the activities of human beings themselves. Since science has dispelled our fears of much of our natural environment, one wonders whether or not it can dispell the fears originating from that part of our environment which consists of other people.

I

I am not going to discuss the nature of scientific understanding in general except to mention two of its features. The most striking feature is that for those questions which are really understood, everybody uses the same answer book. It is in this sense that there is a scientific explanation for the details of the difference in the optical spectra of the hydrogen and helium atom and that there is as yet no scientific explanation why people like music, or why Pauling and Teller disagree

with each other, or, in fact, for the detailed reasons for most differences between people, or, for that matter, of the origin of solar and terrestial magnetic fields. The second relevant point is that there is no unique kind of scientific understanding. Even in one field, such as physics, the Newton-Maxwell-Einstein explanations which connect force and motion are different from thermo-dynamic explanations in which changes occur, not because of a force, but because systems come to equilibrium. For one trained only in classical mechanics, the explanations of quantum mechanics, which provide, for example, for energy fluctuations of the vacuum, and cannot be adequately related to models derived from ordinary experience, do not, at first, really seem to explain anything. Thus one clearly has no basis for insisting that any scientific explanations of human beings necessarily resemble the stereotypes of explanation set by the physical sciences. The cogency and usefulness of an explanation may be apparent only to a narrow group of the initiates in a particular science, and therefore may not be at all compelling to a layman. Nevertheless, the knowledge that scientific explanations for certain phenomena or events do exist, and could in principle be made available to anyone, turns out to be an important statement for everyone, including the layman.

I would like first to try to analyze the effect of the technical powers of science on our fears. Whence this power of science? It is too easy to say that by understanding nature we acquire the power to predict and control our environment. Yet it is this often expressed answer about the effects of science which worries us when it is applied to people. If it is the correct answer, will the fruits of human science result in the ability to predict and control people as they now seem on the verge of doing? Who will control whom? But this easy answer is certainly not correct. Despite the enormous advances in the physical sciences, there is a surprisingly small part of our natural physical environment that we can predict and even less that we can control. We cannot yet adequately predict nor do anything about the weather, or the ocean currents, or

earthquakes. We have no control over, and a very minimum of predictive ability about, solar activity. Meteorites and cosmic rays and aurora fluctuate without any detailed predictability. We have no tool for modifying them. Yet most of these phenomena are quite well understood. Newton gave us no power over the tides or the length of the day or the occurrences of eclipses and the appearance of comets. On the other hand, most of them were somewhat predictable even without scientific understanding. We can control the flow of rivers but this control is clearly not uniquely the result of scientific understanding; beavers build dams. These negative statements, then, are not too reassuring. They do not constitute a proof that further scientific progress will not give man an un-manageable control of man. We do, after all, kill fish with TNT, weeds with 2-4-5-T, and flies with DDT. We kill rats with Warfarin, bacteria with sulphathiazole, and men with bacteria, all as a result of scientific progress.

A brief discussion of the role of prediction in the physical sciences may illuminate its value and limitations in connection with the control of human activity. The ability to predict is an important and essential tool in testing the adequacy and accuracy of our scientific understanding because it is in general possible to explain even complex phenomena and collections of observations in a variety of ways, and with very different theories. This statement is true, for example, of such phenomena as the solar system, atomic spectra, the origin of cosmic rays, the expansion of the universe, or the nature of light. Frequently, subsequent observations will show that an explanation was wrong or, more typically, in the need of refinement and limitation. However, as the science advances, a set of planned crucial experiments becomes a more satisfactory test for a theory. A theoretical physicist can explain almost any collection of data you hand him. One gains confidence in his theory the more thoroughly it can predict the results of as yet unperformed and un-thought-of experiments. The general theory of relativity predicted the behavior of light in the gravitational field of the sun (and the earth).

Yukawa's explanation of nuclear forces predicted the existence of an elementary particle which had never been even remotely suggested by previous observation. The Hoyle steady state theory of the universe predicts that the observed age distribution of the stars in a galaxy should not be correlated with its distance from us. Kinetic theory predicts that the viscosity of a gas, unlike a liquid, should increase with the temperature. The shadow of a straight edge in an electron beam should show an interference pattern. The greater the novelty of the prediction, the more firmly does experimental confirmation vindicate the correctness of the theory.

The spectacular success of theoretical physics, from Newton to Lee to Yang, in predicting confirmable novelty, has, however, exaggerated the predictive power of our physical understanding. For the crucial experiment is a highly artificial device. In some instances, the experiment involves a laboratory set-up; in others, it involves observing the natural course of events, uninfluenced by the hand of man. But in either case the experiment is phrased more or less as follows: if at any time certain conditions are fulfilled and if no overriding but unspecifiable interference occurs, then by concentrating on a narrow aspect of the situation one will make observations that fall within prespecified limits. The crucial prediction does not describe everything that can be observed about the system at the time of the experiment, nor does it guarantee that the necessary and sufficient conditions for the experiment can be achieved. Although this type of prediction is perhaps the most spectacular achievement of science, it is not going to tell us much about the weather.

Science does, in addition, have some practical predictive powers which enable us to achieve some desired effects. The most flamboyant example of this power is probably the Trinity test of the first plutonium bomb. The success of the explosion was a fantastic achievement. Yet it had been preceded by four years of concentrated activity, by calculation by hand and by computer, by countless collateral experiments, by testing of all the components either indirectly or in partial com-

bination. On the tower there was a small very contrived set-up almost isolated from, and in no way dependent on, the rest of the world, yet for those who had calculated and tested and who watched, there was no certainty as to what would happen at time zero. It is of course important that they knew that certain things would not happen. They knew with complete certainty, for example, that no self-sustaining reaction would occur in the atmosphere.

The theoretical limits on prediction have been modified by the insights of quantum mechanics. It is now clear that it would be impossible, even in theory, to specify the initial accelerations, velocities, and positions of all the particles in the universe or even in a bottle of gas, and then, by using the laws of mechanics, to describe these quantities at future times. Quantum mechanics does, however, give reliable and accurate statistical descriptions of large numbers of atoms. If one watched a single radium atom in field-ion microscopy, one would have no idea how long a wait would be required for it to disintegrate radioactively; a second, or ten thousand years. Nevertheless, one can start out with a gram of radium and predict with some measureable accuracy how much will be there one hundred years later. This ability to give accurate statistical predictions has given us undue confidence. It appears that with increased theoretical understanding of the atmosphere and the oceans, or of people and societies, coupled of course with sufficient effort and expenditure of energy in data gathering, and with adequate fast computers, we will be able to make any statistical predictions we care to. Indeed, if the system is not so all encompassing that the data gathering would exhaust available supplies of energy, there may be no theoretical arguments against such statistical prediction. But it is important to realize that, except for the very simplest of situations, even such predictions of averages is very far from being just around the corner.

I would like to illustrate the difficulty with an example from physics. There is probably no phenomenon in atomic physics more precisely understood and more accurately cal-

culable than the hydrogen atom. Because of this precision and simplicity, given pure atomic hydrogen at a very high temperature, we could predict a great deal about the light emitted. We could foretell the frequencies of each spectral line, the shape of the line, and the relative numbers of atoms giving off each color. If we lower the temperature and have a mixture of atomic and molecular hydrogen, the problem is still currently soluble, although to my knowledge no extensive calculations have been made which give the relative numbers of atoms involved in the atomic and molecular transitions. If now we mix helium with the hydrogen, the relative intensities of the molecular and atomic spectra will change. Exactly what happens has not been worked out, but probably could be. If this mixture is now put into a discharge tube, such as a display sign, there are still many features of the light that we could predict, such as the frequencies of the emitted light. But we would be at a loss to predict the relative intensities of the atomic and molecular hydrogen and helium lines. The answer would depend on the pressure, the current, the geometry of the tube, and the proportion of helium in a way that is not understood in sufficient detail, much less calculable. We are not, of course, even here asking for a description of the behavior of individual atoms; we still want only average behavior, but even with this relatively simple and isolated system, we are at the end of our rope.

As the human sciences develop understanding, they must deal with more complex situations. When we introduced the helium into the discharge tube, we were frustrated by a relatively minor example of the kind of interaction and cross-talk that so violently complicates the human sciences. What people decide to do will depend on how much is known about what they are doing. I must add that physicists do not feel in the least chagrined by this frustration in the discharge tube. They know that nothing mysterious or new is involved in the phenomenon, and believe that with a little research it could be explained. In a similar way, it is the level of understanding, the quality of the explanations, and not the clarity of the

crystal ball that must be important to the human sciences. By these I mean to include not only sociology and economics and political science but also the more individual disciplines of psychology, human genetics, and the like. They have their triumphs of crucial prediction; their theories will be of more and more help in developing social tools; but it seems to me that it will be an incredibly long time before they can predict all the important and decisive features of even the average behavior of some segment of society. Since adequate prediction is often a prerequisite for adequate control, it seems clear that we are not compelled to assume, as some would have us do, that improved explanations of human behavior will enable us to predict and control our human environment.

II

But let us return for a moment to our physical environment. It is manifest that we have only a limited ability to predict its behavior, that we have virtually no control over its processes, and that we can modify its structure in only the most local and minor fashion. It is equally obvious that we are no longer as much at its mercy as people once thought they were. If the detailed understandings of the physical sciences have not given us a decisive power to predict and control our natural environment, precisely what powers *do* we gain from our scientific insights?

Apparently what happens is that our sciences, our self-consistent and universally acceptable explanations of natural phenomena, enable us to surround ourselves with an artificial and sufficiently insulating environment which *is* controllable and which adequately enables us to cope with our natural environment beyond the capabilities of our biological inheritance. This formulation of one of the main fruits of science has for me one very appealing feature. It resembles so closely a formulation of the transition from the inanimate to the animate. This transition took place when some complex molecule was able to create reproducibly around itself a cell-

ular environment which enabled it to limit its interactions with the ocean's complex chemistry and so became "alive." As cells coalesced into organisms, they built new "unnatural" and internally controlled environments to cope even more successfully with the entropy-increasing properties of the external world. The useful suggestion of Professor David Hawkins which considers culture as a third stage in biological evolution fits quite beautifully then with our suggestion that science has provided us with a rather successful technique for building protective artificial environments. One wonders about its applicability to people. Will advances in human sciences help us build social structures and governments which will enable us to cope with people as effectively as the primitive combination of protein and nucleic acid built a structure of molecules which enabled it to adapt to a sea of molecular interaction? The answer is of course yes. For the family is the simplest example of just such a unit, composed of people, which gives us both some immunity from, and a way of dealing with, other people. Social invention did not have to await social theory any more than use of the warmth of a fire had to await Lavoisier or the buoyant protection of a boat the formulations of Archimedes. But it has been during the last two centuries, during the scientific revolution, that our independence from the physical environment has made the most rapid strides. We have ample light when the sun sets; the temperature of our homes is independent of the seasons; we fly through the air, although gravity pulls us down; the range of our voice ignores distance. At what stage are social sciences then? Is the future of psychology akin to the rich future of physics at the time of Newton? There is a haunting resemblance between the notion of cause in Copernicus and in Freud. And it is certainly no slight to either of them to compare both their achievements and their impact.

Political theoretical understanding, although almost at a standstill during this century, did develop during the eighteenth and nineteenth centuries, and resulted in a flood of inventions which increased the possibility for man to coexist

with man. Consitutional government, popular vote, trial by jury, public education, labor unions, cooperatives, communes, socialized ownership, world courts, and the veto power in world councils are but a few examples. Most of these, with horrible exceptions, were conceived as is a ship, not as an attempt to quell the ocean of mankind, nor to deny its force, but as a means to survive and enjoy it. The most effective political inventions seem to make maximum use of natural harbors and are aware that restraining breakwaters can play only a minor part in the whole scheme. Just as present technology had to await the explanations of physics, so one might expect that social invention will follow growing sociological understanding. We are desperately in the need of such invention, for man is still very much at the mercy of man. In fact the accumulation of the hardware of destruction is day by day increasing our fear of each other.

III

I want, therefore, to discuss a second and quite different fruit of science, the connection between scientific understanding and fear. There are certainly large areas of understanding in the human sciences which in themselves and even without political invention can help to dispel our present fears. Lucretius has remarked: "The reason why all Mortals are so gripped by fear is that they see all sorts of things happening in the earth and sky with no discernable cause, and these they attribute to the will of God." Perhaps things were even worse then. It is difficult to reconstruct the primeval fears of man. We get some clue from a few remembrances of childhood and from the circumstance that we are probably not much more afraid of people now than man ever was. We are not now afraid of atomic bombs in the same way that people once feared comets. The bombs are as harmless as an automobile in a garage. We are worried about what people may do with them—that some crazy fool may "push the button."

I am certainly not adequately trained to describe or enlarge

on human fears, but there are certain features of the fears dispelled by scientific explanations that stand out quite clearly. They are in general those fears that once seemed to have been amenable to prayer or ritual. They include both individual fears and collective ones. They arise in situations in which one believes that what happens depends not only on the external world, but also on the precise pattern of behavior of the individual or group. Often it is recognized that all the details of the pattern may not be essential to the outcome but, because the pattern was empirically determined and not developed through theoretical understanding, one is never quite certain which behavior elements are effective, and the whole pattern becomes ritualized. Yet often fear persists because, even with the most rigid ritual, one is never quite free from the uneasy feeling that one might make some mistake or that in every previous execution one had been unaware of the really decisive act. To say that science had reduced many such fears merely reiterates the obvious and frequent statement that science eliminated much of magic and superstition. But a somewhat more detailed analysis of this process may be illuminating.

The frequently postulated antique worry that the daylight hours might dwindle to complete darkness apparently gave rise to a ritual and celebration which we still recognize. It is curious that even centuries of repetition of the yearly cycle did not induce a sufficient degree of confidence to allow people to abandon the ceremonies of the winter solstice. This and other fears of the solar system have disappeared gradually, first, with the Ptolemaic system and its built-in concept of periodicity and then, more firmly, with the Newtonian innovation of an universal force that could account quantitatively for both terrestial and celestial motions. This understanding provides a very simple example of the fact that one can eliminate fear without instituting any controls. In fact, although we have dispelled the fear, we have not necessarily assured ourselves that there are no dangers. There is still the remote possibility of planetoid collision. A meteor could fall

on San Francisco. Solar activities could presumably bring long periods of flood or drought. Our understanding of the solar system has taught us to replace our former elaborate rituals with the appropriate action which, in this case, amounts to doing nothing. Yet we no longer feel uneasy. This almost trivial example is nevertheless suggestive, for there are some elements in common between the antique fear that the days would get shorter and shorter and our present fear of war. We, in our country, think of war as an external threat which, if it occurs, will not be primarily of our own doing. And yet we obviously also believe that the avoidance of the disaster depends in some obscure or at least uncertain way on the details of how we behave. What elements of our behavior are decisive? Our weapons production, our world prestige, our ideas of democracy, our actions of trust or stubbornness or secrecy or espionage? We have staved off a war and, since our behavior has involved all these elements, we can only keep adding to our ritual without daring to abandon any part of it, since we have not the slightest notion which parts are effective.

I think that we are here also talking of the kind of fear that a young boy has for a group of boys who are approaching at night along the streets of a large city. If an automobile were approaching him, he would know what was required of him, even though he might not be able to act quickly enough. With the group of boys it is different. He does not know whether to look up or look aside, to put his hands in his pockets or to clench them at his side, to cross the street, or to continue on the same side. When confronted with a drunk or an insane person I have no notion of what any one of them might do to me or to himself or to others. I believe that what I do has some effect on his actions and I have learned, in a way, to commune with drunks, but certainly my actions seem to resemble more nearly the performance of a rain dance than the carrying out of an experiment in physics. I am usually filled with an uneasiness that through some unwitting slip all hell may break loose. Our inability to explain why certain

people are fond of us frequently induces the same kind of ritual and malaise. We are forced, in our behavior towards others, to adopt empirically successful patterns in toto because we have such a minimal understanding of their essential elements.

Our collective policies, group and national, are similarly based on voodoo, but here we often lack even the empirically successful rituals and are still engaged in determing them. We use terms from our personal experience with individuals such as "trust," "cheat," and "get tough." We talk about national character in the same way that Copernicus talked of the compulsions of celestial bodies to move in circles. We perform elaborate international exhortations and ceremonies with virtually no understanding of social cause and effect. Small wonder, then, that we fear.

The achievements which dispelled our fears of the cosmos took place three centuries ago. What additional roles has the scientific understanding of the 19th and 20th centuries played? In the physical sciences, these achievements concern electricity, chemistry, and atomic physics. In the life sciences, there has been an enormous increase in our understanding of disease, in the mechanisms of heredity, and in bio- and physiological chemistry. The major effect of these advances appears to lie in the part they have played in the industrial revolution and in the tools which scientific understanding has given us to build and manipulate a more protective environment. In addition, our way of dealing directly with natural phenomena has also changed. Even in domains where detailed and predictive understanding is still lacking, but where some explanations are possible, as with lightning and weather and earthquakes, the appropriate kind of human action has been more adequately indicated.

Apparently the population as a whole eventually acquires enough confidence in the explanations of the scientists to modify its procedures and its fears. How and why this process occurs would provide an interesting separate subject for study. In some areas, the progress is slower than in others. In

agriculture, for example, despite the advances in biology, elaborate rituals tend to persist along with a continued sense of the imminence of some natural disaster. In child care, the opposite extreme prevails; procedures change rapidly and parental confidence probably exceeds anything warranted by established psychological theory. There are many domains in which understanding has brought about widespread and quite appropriate reduction in ritual and fear. Much of the former extreme uneasiness associated with visions and hallucinations and with death has disappeared. The persistent horror of having a malformed child has, I believe, been reduced, not because we have gained any control over this misfortune, but precisely because we have learned that we have so little control over it. In fact, the recent warnings about the use of X-rays have introduced fears and ambiguities of action which now require more detailed understanding, and thus in this instance, science has momentarily aggravated our fears. In fact, insofar as science generates any fear, it stems not so much from scientific prowess and gadgets but from the fact that new unanswered questions arise, which, until they are understood, create uncertainty.

Perhaps the most illuminating example of the reduction of fear through understanding is derived from our increased knowledge of the nature of disease. The situation with regard to our attitude and "control" of disease contains close analogies to problems confronting us with respect to people. The fear of disease was formerly very much the kind of fear I have tried to describe. I need not list examples of such terrors in former centuries for they are well known indeed. The difference between our present fear of cancer and our fear of a coronary thrombosis illustrates how sensitive our uneasiness is to the level of understanding. Neither occurrence is as yet very well explained. Yet cancer is, I believe, the more dreaded of the two, not because it is more lingering, but because we know so little about the connection between its etiology and our own actions, such as smoking and being bruised and coming in contact with certain chemicals or X-rays. Yet even

cancer is more clearly understood today than disease in general was before the 18th century. Thus our fears and our rituals in connection with it are not extreme when seen in perspective.

Let us pursue the question of our treatment of disease somewhat further, for it leads us back to the distressing question of the role of science. It is true that in our knowledge of disease we can see quite clearly the subjective effect of understanding on our fears and malaise. There are, in addition, many examples of the way scientific understanding has enabled us to devise an artificial environment in which the biology of man is more secure than it would be in the naturally occurring one. The practices of cleanliness and asepsis, of providing vitamins and, more remarkably, of vaccination, insulate us and render us immune from the processes of nature but do not give us much control over them. Yet here is the rub. There are also practices where this distinction is not at all clear-cut, and indeed, there are others in this domain in which we manifestly dominate nature. When we rid an area of mosquitoes to prevent malaria, we create a new environment for ourselves at the same time that we kill and prevent the reproduction of mosquitoes. When I was a boy, I had a most intense fear of "blood poisoning." Knowledge of the existence of streptococcus was of no avail in dispelling this fear. There was no sufficiently fool-proof environment to prevent an infected foot, a ruptured appendix, or a diseased mastoid bone. Now, however, since we have learned how to kill the streptococci with sulpha drugs and prevent their multiplication with antibiotics, my fear is gone. Possibly, if we had better understanding, we could develop self-defensive weapons against streptococcal infection, as we have done in the case of polio and tetanus. But for the present, at least, we are forced as a last resort to use a coercive tool, for such is the action of penicillin on bacteria. Do our techniques for the control of micro-organisms have implications relevant to the fruits of the social sciences? Although the analogy may be over-extended and the problem over-simplified,

it is difficult to extricate one's thinking from the following uncomfortable rut: if we have to admit the necessity of coercion in human relations, whether this exercise of controllable force be physical or economic or mental or however "civilized," then the human sciences will be of little avail in dispelling man's fear of man. As technology and education expand, all the instruments of coercion will be available to everybody. The symmetry of the situation may well be such that the use of coercion will be impractical and immoral. This immorality may well become universally recognized. Yet, if we cannot discover a more effective last resort than coercion, man will continue to fear his environment of man. Any large-scale ultimate reliance on coercion would indicate the inability of the social sciences adequately to understand human beings. It would imply that human sciences could not provide through their technologies such as families, schools, United Nations, and the like, the necessary innovations of social environments adequately to protect people from one another. Alternatively, it would mean that the social sciences could not, through their explanations, replace the fears, uncertainties, and disparities that inevitably accompany empirically derived procedures and could not substitute in their stead the peace of mind and simplicity of action that apparently results from theoretically understood interactions.

IV

The dogmatism here is not an assertion of my belief but of my difficulty. I recognize of course that this is not my rut alone but that it has been an eternal and universal one. However, the formulation of it in juxtaposition with the physical sciences has been somewhat illuminating. The many noncoercive triumphs of the physical sciences in dispelling fear, although they convey no assurances, do carry a certain exhilaration into the possibilities for the human sciences. The present insights of the social sciences, even in their most obscure domains, are now much greater than any scientific

understandings during the 15th century. We now have the taste of scientific clarity and know its many powers. We inherit from Darwin and Freud the conviction that society and human beings are essentially understandable. The biological sciences are developing with extraordinary rapidity and it is not improbable that, due to the current exponential rise in intellectual activity, the social sciences will develop, perhaps within a generation, the detailed and interlocking kind of understanding that has characterized the physical sciences.

It has been pointed out that the social engineers are beset with additional difficulties. Their inventions are not as readily accepted as are refrigerators, automobiles, and atomic bombs. There always appear to be strong forces opposing any major social innovation. The strength of this resistance is attributed to the fact that social change threatens the vested interests of the dominant social and economic groups, as indeed they usually do. But perhaps part of the success of such resistance to change is due to the fact that people in general are quite sensible and that they resist proposed changes for the same reason that any of us would object to a co-passenger on an airliner making a major improvement in the wing shape just before take-off: the stakes are too high and the chance that the change will be an improvement too small. If something is working moderately well (as is, for example, the human genetic constitution), any arbitrary change is likely to be for the worse. In the absence of understanding, however, the present cut and try method is the only one available for progress. On the other hand, as confidence is gained in the explanations of the social sciences, it may well be that the possibilities and processes of social change will have to be re-evaluated.

I would like to make one further remark concerning physics and biology which may have some bearing on the fruits of the human sciences. In general, increased understanding has reduced the variety of the interactions we invoke to explain natural phenomena. We now are aware of the only

three different kinds of forces in physics; major similarities exist between complex biochemicals of very different origin and function. There are only four pyrimidenes in the basic alphabet of heredity and only 32 essentially different symmetry forms of crystals. This trend in the sciences suggests that perhaps we now exaggerate the scope and complexity of the mutual interactions of people. In addition, the responses to natural phenomena that have followed understanding are, for the most part, very much simpler than the actions dictated by pre-scientific ritual. It could well be that what we now do in order to get along with people is much more elaborate than our conduct will be when we can more adequately explain human behavior. It is impossible to forsee what obstacles may delay the progress of these explanations. Although we were able, for example, to explain the main features of the solar system without having to wait until we knew the mechanism of heat production in the sun, we had to delve much deeper to learn anything significant about cosmic rays. To understand cosmic rays we had to invoke features of the earth's atmosphere and magnetic fields, the properties of solar flares, the structure of the galaxy, the nature of supernovae, and the laws of nuclear physics. It is apparently impossible, at the moment, to determine to what depths psychologists will have to probe into biochemistry and neurology. It is also clearly impossible to assess the obstacles in the pathways of the social sciences. The notion of a universal gravitational force could probably not have been disentangled from Ptolemy but had to await the Copernican re-description. The great advances in the mechanical sciences did not insure progress in chemistry for it had to await the realization that gasses were not qualities, like kindness, but were substances that could be collected and measured.

In the past, people have relied on the protection afforded by their ability to enslave and subjugate other people. But the advance of science in general and the release of nuclear energy in particular seems to require a change from the patterns of the past. Whereas we may have increased our ability

to make changes in our physical environment, there no longer is any safe way in which people can coerce one another. My purpose here has been, not to assert that coercion is impossible, but to ask whether it is essential.

Do the physical and biological sciences provide a relevant pattern for the human sciences? If we can learn to explain human behavior but not necessarily predict or control it, can we devise the tools to build a social environment that protects us from human beings as a house protects us from the cold or a vaccination from smallpox? The purely empirical rules that we now rely on are unavoidably discrepant and are therefore filled with conflict and uncertainty. Will we ever be able to understand ourselves and the interactions between people sufficiently well that we can establish compelling and universally accessible theoretical arguments to serve as a guide to action and decision?

When we look into ourselves, it is of course not easy to believe that science will bear such fruits, for we all seem to have such a knack for, and even, on occasion, a drive towards self-destruction. It is a big order to require that a sizeable fraction of humanity could be induced to act consistently so as to preserve the whole. Yet it is possible to unclutter some of the stairways to the upper reaches of our minds and thus be able to make fuller use of the promises of all the sciences.

WEAPONS TECHNOLOGY AND INTERNATIONAL STABILITY

J. David Singer

ONE OF THE ENDURING AND MOST intriguing issues in social science is that concerning the relationship between a given phenomenon and its environment or milieu. Those on the ecological or environmental side tend to see the individual phenomenon pretty much as the natural consequence of its milieu, and as arising out of it. Others, with a more microscopic approach, tend to focus on the isolated phenomenon, or class of phenomena, as the causal element in the relationship. Sociologists, economists, psychologists, historians, geographers, and political scientists have wrestled with this issue for generations, but as far as I can tell, with only inconclusive results.

Thus, rather than proceed from one or the other of these two approaches, and shed little light on the larger controversy, I plan to use both approaches in examining a particular case of the relationship between a class of phenomena (technological revolution in military weapons) and its environment (the international political system). Having thus dispensed with (or ignored) the larger theoretical problem, let us get on with the particular aspect of it which concerns us here. In this article, I will first discuss the impact of the systemic environment upon weapons development, then the reverse, and conclude with some possible approaches to the creation of a more stable relationship between our two sets of variables: military technology and its political environment.

I. The International System and its Effect on Weapons Technology

As a first step in our analysis, let us examine some of the

characteristics of the international system—that political environment within which national states exist. At the outset it must be emphasized that it is to this environment which the nations must adapt if they are to fulfill their primary objective—continued survival as distinct socio-political and territorial entities.

Perhaps the most striking characteristic of this environment is that it offers very little in the way of security or protection to its national components. On the contrary, the international system comes extraordinarily close to the anarchy end of the anarchy-order continuum, providing almost nothing in the way of institutionalized procedures by which inter-nation conflicts may be prevented, ameliorated, or resolved, or by which the weaker may be protected from the stronger.

To be sure, the contemporary system does have a multitude of institutions within which nations may find machinery for the facilitation of cooperation. There is the United Nations Organization and its array of specialized agencies, and there is the not insignificant heritage of several hundred years' effort to evolve a legal code of the rights and duties of members of the international community, but these offer little more than the *opportunity* to cooperate. They provide only a negligible *incentive* to cooperate, and even less *compulsion* to cooperate. As many students of the League of Nations and the United Nations have pointed out, the major virtue of these organizations is not that they can assure the maintenance of peace, but that they provide an accurate reflection of the "realities" of the international political system.

Not only does the political environment of nations not offer much in the way of incentives and compulsions to engage in essentially cooperative behavior, but it actually provides some powerful *dis*incentives. Primary among these is the historic tradition or norm which establishes that, in pursuing their goals, nations utilize physical force. How this tradition became established is another question, but that it is a fundamental pattern of behavior one may hardly doubt.

Thus, even if any single nation, as a result of some concatenation of domestic and external factors, were anxious to eschew force or the threat of force in pursuing its goals, it would find such a path extremely dangerous. To an extent far greater than that used by modern Western businessmen in justifying their devious tactics as essential to survival in a "dog-eat-dog" milieu, the contemporary nation is the almost helpless victim of the operational code of all of its neighbors. The behavior of each is a function of the behavior of all, and none can afford to act at variance with such physically-oriented actions of its neighbors.

Given such a setting, the individual nation is confronted with the unpleasant choice between military preparedness and unilateral military nudity. For a multitude of reasons, most of them prefer the risks of the former course, which at least offer the virtue of familiarity when compared to the risks associated with complete defenselessness. One of the attendant consequences of such a choice is the pursuit of weapons improvements. Despite the inhibitions of economy-mindedness, popular resistance to armaments research and production during peacetime, and the lack of human and material resources in the peacetime military establishments, there is always some degree of improvement in weapons technology in inter-war periods. And as the subjective probability of war increases, so does weapons research, reaching, of course, its greatest crescendo during war itself. Though World War II saw the advent of nuclear weapons and the beginnings of a long-range missile, these two harbingers were extraordinarily primitive and ineffectual by contemporary standards. But faced with a struggle for survival, the U. S. found the crude twenty kiloton bomb an adequate recompense for its research investment, and Nazi Germany—likewise locked in total war—came close to victory itself with the long-range rocket which arrived just a few months too late.

The post-World War II period, marked as it has been by several limited wars and by a high probability of total war, is producing an even greater tempo of weapons development

than that experienced during the global conflict which marked its beginning. As Herman Kahn points out, the military "technological revolutions," which occurred twenty years apart (1920-40) earlier in the century, now occur every five years, and may be expected to take place every four years in the decades immediately ahead. The United States, for example, spends four times as much on weapons research and development now as it did during the peak of World War II. The rapidity of the contemporary research and development revolution is illustrated by this excerpt from President Eisenhower's budget message of 16 January 1961:

> Just a few years ago, the United States was programming twice as much money for manned bomber systems as for strategic missile systems. The budget for the coming fiscal year, by contrast, programs more than four times as much for strategic missile systems as for manned bomber systems. Similarly, defense against ballistic missile attack took only a small part of the total capital investment in continental air defense as recently as the fiscal year 1957, whereas in the coming fiscal year, it will be a substantial percentage of the total.

As long as the Soviet and American elites perceive nuclear war between them as a fairly probable event, it can be assumed that each will invest a high level of physical, intellectual, and organizational energy in the development of "better" weapon systems and in defenses or counters to such systems. And even if this particular cold war (or pre-war, as it is seen by many of the participants) situation were to be relieved, the tempo will merely be slowed down, rather than halted. But with any resurgence of international tension, it can be expected that weapons research and development will again pick up speed. To this very considerable extent, changes in military technology are a consequence of the political environment within which nations interact.

II. Military Technology and its Inhibitory Effects

Having noted the general way in which the international

political system compels the nations to engage in an ever-increasing race in technological innovation, let us turn now to the other side of the coin, and explore some of the ways in which contemporary military technology influences the behavior of nations, and hence affects the international system.

The weapons development which most concerns us here is that which combines the high-speed, long-range ballistic missile with the powerful megaton nuclear warhead, and the impact of this lethal marriage is of a most paradoxical nature. On the one hand, this nuclear-missile weapon system has introduced some powerful *inhibitions* into the competitive and conflicting relations among nations, and there seem to be two reasons for this inhibitory impact. Firstly, there is the awesome destructive power of the nuclear warhead, now capable of devastation levels many times greater than those experienced by the citizens of Hiroshima and Nagasaki. Faced with the possibility of tens of millions of human casualties and near-decimation of industrial and transport facilities, as well as the loss of much of the military force itself, national leaders (especially in the major powers) tend to employ somewhat more cautious strategies than in earlier military environments. Events and provocations which, prior to the nuclear-missile era, might well have called for a military response now lead to such relatively non-violent reactions as diplomatic protests or condemnatory resolutions in the United Nations General Assembly. The nineteenth and early twentieth-century *casus belli* is now more likely to be little more than the occasion for political rebuke or verbal recrimination.

The second reason for the inhibitory impact of the revolution in military technology is found in the width of the gap between offensive and defensive type weapons. Without suggesting that all weapons of all ages readily fall into one and only one of these two categories, I would nevertheless contend that the distinction between offensive and defensive weapons is evident and obvious enough to be meaningful. Historically, offensive implements have always enjoyed a

chronological lead over their defensive counterparts, as one cannot readily design and produce the latter until the former have appeared and their characteristics and capabilities have been ascertained. However, a reasonably effective defense has always been forthcoming, and seldom has the offensive advantage lasted long enough or been dramatic enough to play a strategically decisive role in war. Thus it is probably safe to predict that a defense against both the contemporary warhead and its delivery system will ultimately be found. Today, both the Soviet Union and the Western allies are working feverishly on a variety of partially promising defensive measures. Against the intermediate range ballistic missile, there are several fairly auspicious looking ground- or plane-launched interceptor missiles under development which rely upon a self-correcting guidance system and proximity-type detonators for effectiveness. But such interceptors are still several years away, and even more in the distance is an interceptor capable of dealing with the high-trajectory *intercontinental* ballistic missile, to judge by the program of the U. S. Defense Department's Project Defender. In addition to the obvious ploy of attempting to shoot down the offensive missile, both sides are also pursuing such other and more indirect techniques as deflecting its course by the creation of artificial magnetic fields or jamming its guidance system by the use of electronic counter-measures. As to dealing with the warhead itself, research is going forward on techniques which might achieve its predetonation either at a rate slow enough to minimize radioactive blast or far enough from its target and high enough in its trajectory to cause little damage to the defender.

Despite these herculean efforts, however, we may readily assume that for the next several years the great advantage of the offense will continue, thus perpetuating the awareness of how devastating nuclear-missile war can be. And if statesmen are confronted with weapons of great destructive power, against which adequate defenses have yet to be produced, they will normally tend to avoid those forms of behavior which raise the probability of such weapons being used.

Though Winston Churchill's dictum to the effect that the very destructiveness of the nuclear-missile combination might well prevent war may be something of an optimistic overstatement, there is little doubt that their development does impose restraints quite new to international relations.

III. Military Technology and its Aggravating Effects

Let us now shift our focus from the ways in which the new weapon systems may help to avert war and examine some of the pressures by which they increase the propensity to war. Clearly the greatest de-stabilizing effect of the nuclear-rocket revolution lies in the degree to which it has enhanced the attractiveness of getting in the first blow. Turning again to World War II, we recall that it was the Axis powers who, time and again, were able to strike the first blow. In Poland, in France, in Norway, and at Pearl Harbor, the speed and destructiveness of the Nazi and Japanese attacks sent the defenders reeling. But despite the initial effect of the "blitzkrieg," the Allies were eventually able to recover and ultimately wrest victory from the attackers. And on the Russian front, Stalin's doctrine of the ultimate dominance of the "permanently operating factors" was vindicated, and the initial German victories finally negated.

Such a military sequence is unlikely, however, to occur again, at least until we pass into another technological revolution. What are the specific characteristics of contemporary war which add to the desirability of striking first? Primarily, the incentive lies in the possibility of doing so much damage in one's opening attack that the victim is left almost incapable of striking back. Such a cheap victory is a function of two sets of variables. One is the level of destructiveness and inadequacy of the defense discussed above. In this context, however, the effective motive is not so much the elimination of the victim's cities, populations, and industries as it is the debilitation of his retaliatory forces. If the attacker is able to obliterate not only the basic war potential of the enemy but

those forces by which he might strike back, the incentive cannot but be high. The other variable in this equation is speed. Even if the attacker does not enjoy the numerical and qualitative superiority by which to overwhelm an *alerted* victim, he may well find his capabilities adequate if they are utilized in a surprise attack. In a prior era—that of the manned bomber—a reasonably alert defender could be assured of adequate warning time, during which he could man his anti-aircraft batteries, send his interceptor craft aloft, evacuate his factories, partially disperse his ground forces, and launch his own offensive aircraft. Today, as the bomber is being phased out and the missile steadily replaces it, such warning time becomes decreasingly available. This delivery system can carry its nuclear payload to a target 6,000 miles away in less than thirty minutes, and detection systems currently available (January, 1961) can provide no more than half of that time in the form of early warning. With this constant compression of warning time, the victim becomes decreasingly able to either minimize the destructive effects of the strike or to launch successfully his own vehicles of retribution.

One of the more alarming repercussions of this dual capacity of the attacker to achieve surprise and to wreak such devastation lies in the area of what is known as response time. Because of the menace of an opening surprise blow, the potential victim is compelled to do everything possible to keep his own response time as brief or briefer than the anticipated warning time. Therefore, he must design his retaliatory system so that it can be alerted and launched during those precious moments between warning and impact. Whatever effectiveness the retaliatory capability has in deterring a potential nuclear aggressor depends upon the degree of damage that aggressor must accept in response to his own attack. And that degree is today (in the absence of an effective anti-missile weapon) a function of the number of delivery vehicles the victim can launch prior to the attack, or can shelter from that attack. Without denying the virtues of the latter passive pro-

cedure (hardening, moving, dispersing, concealing, etc.), it is still a less promising one than the former—launching the counter-blow before the warheads strike home.

But how does the victim know for certain whether and when the enemy *has* actually launched a first-strike attack? When can he establish, beyond reasonable doubt, that he is about to receive the dreaded barrage with its cargo of blast, heat, and radiation? The difficulty is, of course, that he cannot, given the limitations of contemporary detection devices. Therefore, he will have to make his decision to retaliate and to launch his strike on the basis of rather fragmentary, ambiguous, and conjectural "information." Given this need for haste, the probability is high that one side or the other, confronted with such a sudden-death dilemma, may well "retaliate" against an enemy which never launched in the first place.

Closely associated with this reciprocal fear of surprise attack is the impetus to make either a "preventive" or "preemptive" strike. If either side's decision-makers become convinced that military showdown is inevitable or nearly so (and the contemporary international system exerts a powerful force in this direction), they may well decide that it is better to get in the first blow at a time of *their* choosing, rather than abdicating that advantage to the adversary; the result is a "preventive" strike. Or if they begin to accumulate, during a given brief period, the sort of intelligence information which suggests that the enemy is just about to—or already has—launched the opening blow, they will be under tremendous pressure to pre-empt, shifting the advantage from the enemy to themselves. The major result, then, of the superimposition of the nuclear-missile weapon upon a hostile and suspicious pair of adversaries is the escalation of the probability of an accidental war, touched off, not by the actual aggression of one, but by the expectation of such aggression. Here is a striking example of the self-fulfilling prophecy. Thus, we see that while there is an inhibitory and stabilizing side to the appearance of this new technology, it tends to be strongly degraded by the provocative and de-stabilizing effects.

IV. Some Approaches to the Armament Problem

Up to this point, we have discussed in turn: (a) the degree to which the realities of international politics lead to a constantly accelerating development of weapons technology; (b) the extent to which contemporary technology tends to stabilize the political relations and inhibit the tendency toward war; and (c) the ways in which it *de*-stabilizes and generates a propensity toward war. For the concerned observer of these relationships, then, the crucial question is this: what steps might the nations take to enhance the inhibitory and stabilizing role of current weapons technology and to minimize their aggravating and de-stabilizing effects? And out of this question flows an obvious corollary: will rational and well-considered measures on the part of the powers involved be sufficient, or will the national leaders have to go beyond such short-run steps and actually seek to modify the international system itself in order to survive?

As I see it, the wide range of possible responses to these questions cluster around five rather discernible positions: (a) the win-the-war, inevitable showdown school; (b) the deterrers, crude or sophisticated; (c) the arms controllers; (d) the multilateral disarmament proponents; and (e) the neo-pacifistic, unilateral disarmers. Also I assume that while each of these positions is based on groupings in the West, each has a more or less equivalent opposite number in the Soviet bloc. Let us discuss each of these approaches briefly.

At one end of the arms policy continuum, there are those in the United States, Soviet Union, and elsewhere who are so convinced of the inevitability of an ultimate military showdown that they can only advocate policies which aim at "victory." These are the people who oppose any concessions to their adversary in the political realm as well as concessions to those at home who would sacrifice certain types of win-the-war capability in order to maximize their prevent-the-war, deterrent, capabilities. Advocating an all-out qualitative and quantitative arms race plus vigorous civil defense pro-

grams, these are the oracles of the self-fulfilling prophecy.

Next to them, and perhaps dominant in both major powers today, are the proponents of a deterrent-through-strength policy. Though they differ sharply among themselves, their general approach is one which does not relish war and does not consider it inevitable, but postulates that the best way of avoiding it is to be well prepared to fight it. The key arguments among the total war deterrers concern two vital issues: the nature of the targets that will be hit by a retaliatory strike and the timing of that strike. One school contends that the adversary will be deterred if you are merely able to destroy much of his cities and industry in the retaliatory strike. This minimum or "finite" strategy is rejected by those (led, in the United States, by the Air Force) who feel that one must be able to eliminate most of the aggressor's military capability as well as his citizens and factories, in order to deter; they are advocates of a "counter-force" doctrine, as opposed to a "counter-city" doctrine. Not entirely by coincidence, the counter-force proponents also take a more extreme position on the timing question. That is, given reasonable certainty that the enemy is about to strike, they favor getting in the first—or pre-emptive—blow. The finite, counter-city deterrers, on the other hand, are somewhat more concerned with the dangers of an unwarranted and accidental pre-emptive strike, and hence insist on not launching their missiles of retribution until the other side has, beyond a doubt, launched their strike first. These latter, therefore, are deeply concerned over protecting their retaliatory forces so that, no matter how massive the opening attack may be, they will nevertheless retain the ability to render devastating punishment to the attacker's cities. While there are several sound reasons (deterring limited military probes or nuclear political blackmail) for developing a counter-force capability—which is essentially identical to a first-strike capability—the basic premise is quite fallacious. If you arm only to deter and only to strike back, why have missiles and warheads of such quantity and design (thrust and accuracy of missiles, explosive power of

warheads) as to be able to destroy the enemy's strategic forces? If he strikes first, all or most of his strategic forces will have been launched well before your strike-back ever takes place. As the finite deterrers and others have pointed out, a counter-force capability coupled with a pre-emptive doctrine looks much like a first-strike posture, and constitutes therefore a most provocative and de-stabilizing policy.

It is this realization on the part of the more sophisticated deterrers that brings them rather close to the third general position on the arms policy continuum: the arms control advocates. The proponents of what has come to be called arms control view national armaments as a manifestation of international politics which will be with us for some time, but are concerned that this continued presence may produce a thermonuclear holocaust by accident, miscalculation, or Nth power mischievousness. Thus, while advocating neither disarmament (at least in the near future) nor crude deterrence, they seek certain means of controlling and regulating the armaments race. The objective is not to eliminate weapons particularly, but rather to stabilize the environment to which these weapons contribute. The emphasis is on such anti-provocative unilateral steps as finite capabilities only, no *civil* defense but invulnerable retaliatory systems, and highly cautious command arrangements, and on such multilateral measures as mutual surveillance, effective intercommunication nets, third-party inspection, etc. The arms controllers are committed to the proposition that, with the proper mix of imagination and caution, the arms race can go *on* without going *off*.

Next to the arms controllers—and often overlapping—are the multilateral disarmament advocates. Terrified over crude deterrence, concerned over sophisticated deterrence, dubious over arms control, they feel that today's weapons contribute so crucially to instability in the international system that they must ultimately be removed from national possession. Though there is—as in each of the other positions—much diversity among the multilateral disarmers, they do agree

that arms control is little more than a stopgap approach and that the major powers must soon begin to negotiate the *reduction and elimination* of certain classes of weaponry at least.

Finally, there are the unilateral disarmers—though they seem to be much less vocal in the U.S.S.R. than they are in the West, especially Britain. These are the concerned observers who not only agree with the reservations of the multilateralists, but go beyond them on two counts. Firstly, they note the dismal record of disarmament negotiations before and since World War II and have little faith in the diplomatic bargaining process. Secondly, they fail to share completely their countrymen's image of the enemy: aggressive, belligerent, devious, and conspiratorial. Rather, then tend to err in the opposite direction, and attribute most of the war danger to their own nation, or an ally, rather than to the adversary. The unilateralist would have his nation disarm unconditionally, trusting to example, world opinion, and the forces for peace on the other side.

These, then, are some of the basic responses to the contemporary military situation. Which look most promising? The balance of this article will spell out some of the author's general views on how the two super-powers might best cope with the awesome dangers arising out of the combination of nuclear-missile technology and an anarchistic international system.

V. From Deterrence to Disarmament

Let me begin by rejecting the two terminal positions on the arms policy continuum. I do not think that nuclear war between the Soviets and the West is inevitable—only that it is highly probable. But the best way to convert high probability into near-certainty is to proceed on the assumptions of the latter. My preference is for policies which maximize the chances of avoiding the military showdown without engaging in political surrender—even if such policies require certain steps which would diminish one's win-the-war capabilities if

deterrence fails. Likewise, I would reject the unilateral disarmament position at the other pole, but with less alacrity. Though not optimistic about any of the other approaches, the pacifist one seems to me, as the detached observer, the one most unlikely to be adopted by either side, and as an American liberal, too optimistic as to how the Soviet would deal with a disarmed West and a highly vulnerable Asia, Africa, and Latin America. They *might not* exploit our disarmament in illiberal and totalitarian ways, but then again, they might. This leads me to emphasize that the most mature response to international crisis is one which can cope with a certain *range* of behavior on the part of the instigator. Though it requires the sort of hedging alluded to above, it seems wiser to develop the posture and capabilities which could meet either a Soviet which is bent on military showdown or a Soviet which is committed only to competitive coexistence. The fact is that none of us is *sure* of Soviet intentions (perhaps including the men in the Kremlin themselves) and it may well be possible that *our* behavior will strongly determine their course in this matter.

In thus avoiding the position of either the naive pessimist or the naive optimist, we must seek a careful synthesis of the three remaining approaches: sophisticated deterrence, arms control, and multilateral disarmament. As I see it, both sides must have total disarmament as their ultimate aim, with arms control providing the transition between the contemporary situation of mutual deterrence and the eventual world of disarmed national states.

Taking first things (chronologically, at least) first, we must do much more of a unilateral nature to build greater stability into the present delicate balance. This means that we must do everything possible to make our posture look like a deterrent and retaliatory one only. Even if it involves certain sacrifices in our win-the-war capabilities or requires accepting a higher casualty rate if deterrence fails, we must avoid the development of weapon systems and doctrines which are inherently provocative. For example, both sides if possible

and one side if necessary, should build strike-back systems only. This means that they must eschew above-ground, soft and vulnerable, close-in missile sites. Being nearly worthless for strike-back missions, they only suggest strike-first intentions to the other side. They must eschew large-scale civil defense programs, despite their admitted worth if the nuclear-missile exchange *does* take place. Thirdly, they must avoid those intelligence operations designed to locate the other's retaliatory sites. In this connection, the U-2 flights were perhaps even more provocative than Khrushchev made them out to be. If ours is a retaliatory policy only, with Soviet cities and populations as hostages, there is no need to locate their launch sites and air fields. Such operations, while a concession to the counter-force, pre-emption advocates, only strengthen the hand of the identical advocates on the other side.

But even if both sides do exercise real restraint, and focus exclusively on a minimum deterrent, non-provocative program, the accumulated fears and suspicions still make the relationship extremely unstable. Thus, each must also press the other side to negotiate (either formally or in a tacit and informal fashion) certain mutual arrangements in the arms control area. Among these might be a ban on the testing of both the nuclear warhead and the various delivery systems. Though much has been written on the former, little has been said regarding missile and rocket testing. Despite dramatic advances, the guidance systems and the propellants are still far from perfected, and today's operational missiles are still more effective as counter-city than as counter-force weapons. There may still be time to keep them so limited. Furthermore, the testing of these vehicles is not only provocative and de-stabilizing in its technological impact, but in that the very test launches themselves might start the chain of events leading to accidental war. Thus, we should press for an agreement whereby no tests of military delivery systems can take place, and in which the multi-purpose (civilian and military) satellite launchings are conducted only under United Nations control. This would not only inhibit the improvement of the

military vehicles and eliminate the chances of a test launch leading to accidental war, but would provide us with the beginnings of an international control agency in an area highly susceptible to inspection verification.

Another step in this realm would be the establishment of a United Nations monitoring system for early warning of surprise attack. The key objective here is not only to buttress the individual nations' early warning systems and thus contribute to a diminution of each side's fear of being taken by surprise, but to provide that continuous *positive* intelligence that assures that the other is *not* launching such a strike. Again, such measures could be both confidence-building and conducive to a growing U. N. role in the weapons control field.

Despite the fact that such arms control agreements could certainly diminish the likelihood of war without seriously affecting either side's win-the-war abilities, I would contend that even this is inadequate to the needs of the time. I would therefore suggest that even as progress in controlling and stabilizing the stand-off takes place, the major powers must explore, study, and negotiate steps toward total disarmament. Let it be stated at the outset, however, that as complicated as it may be to negotiate stabilizing measures, they are relatively simple when compared to genuine arms reduction and elimination. Not that the inspection systems need be any more onerous and elaborate; as a matter of fact, many arms control arrangements will call for more elaborate inspection machinery than many disarmament arrangements. The real difference, and the major difficulty, is that disarmament requires some basic and radical changes in the behavior and "rights" of nations, especially as we move from partial to comprehensive disarmament. And it is this need for major changes in the international system which puts off many who would otherwise favor disarmament and which escapes some of the more misty-eyed disarmament enthusiasts.

First of all, if comprehensive disarmament in the nuclear-missile as well as conventional fields (not to mention bacteriological, chemical, and radiological) were to be negotiated

successfully, and if the agreements were carried out with reasonable compliance, it would mean that nation-states, for the first time in their collective history, would no longer be able to resort to force or threaten such resort in conflicts with one another. This may seem to be a rather pedestrian observation, but when one recalls that military force—its use and threat—has been the major medium of inter-nation intercourse for about 500 years, it becomes clear that such an eventuality might well strike terror into the hearts of statesmen. The risks of arms races and war may be great indeed, but at least they are somewhat familiar; diplomacy without military force would be a most awkward game for many of these people to learn. The implications of evasion in a disarmament scheme, even if the probability is low, are typical of the relatively *un*familiar risks in a disarmed (or disarming) world.

In addition to the awkwardness and unfamiliarity of a world in which the nations were deprived of mass-destruction weapons, there are such questions as: what protects the nation which does disarm against those who successfully evade? who supervises the arms reduction process? who or what replaces force in the inter-nation conflicts which will be with us ages after the last national arsenal has disappeared? and (not being facetious) what happens to those civilians and soldiers whose livelihood has depended for years upon arms races and intermittent wars? Until one has wrestled with this type of question, he ought to take a very tentative position toward comprehensive disarmament. It seems to me that the only promising answer to all these questions lies in the development of a far more powerful international organization than the one we now have. These tasks can not be handled by the nations themselves (even by the neutrals of the moment), and the U. N. is far too weak to handle them, as it is now constituted. Therefore, the nations must—if comprehensive disarmament be their goal—find a way of converting the facilities of the U. N. into the sort of quasi-governmental organization which can manage the inspection, adjudication,

and enforcement functions which a disarmed system of nations will require.

As everyone knows, of course, one must do more than assign certain powers to certain institutions or groups via a paper document, and expect that institution to fulfill its new roles and assure compliance as of the next morning. The two essential ingredients—in some combination or mixture—are agreement with the basic procedures established and some level of persuasive or coercive power for the use of that institution when such agreement or consensus wavers. How achieve such a dual combination?

In the past, whenever students or practicioners of internation relations have addressed themselves to the disarmament question, they have tended to think in terms of the scrapping of existing weapons and the absolute or partial prohibition on the fabricating of new ones. As a result of this emphasis, two difficulties arose. Firstly, nations were reluctant to entertain the plans seriously because they did not provide for their protection during and after disarmament. And secondly, on those few occasions when the actual arms reductions did occur (or at least begin), the signatory nations were not confronted with any impartial international agency with a force of its own, which could compel compliance when the temptation to violate became irresistible.

By now, it should be clear what I am leading up to. My proposal would be that only *some* of the national weapons be scrapped or converted to peaceful uses during a multilateral disarmament process. The balance must be transferred to the custody and control of our international organization. If the negotiated arms reduction schedule is carefully drawn up (and adhered to), we would see, over a five or ten year period, the gradual diminution of the individual nations' war-making capabilities, coupled with a gradual build-up of the U. N.'s persuasive and coercive capabilities. Space prohibits any detailed dismission of the problems inherent in this approach and the possible solutions to them, but a few brief comments are nevertheless in order.

The first consideration is that conventional and nuclear weapons are quantitatively different enough to warrant separate treatment. Thus, I would suggest that while conventional weapons be gradually transferred to a slowly increasing U. N. force, for prestige, deterrent, and enforcement purposes, nuclear stocks be stored by the U. N. for safe-keeping and ultimate conversion to peaceful uses, but that they not be maintained operationally by the U. N. or stored near their missile delivery systems. Secondly, the nations have invested heavily in the development and production of their weapons, and they must therefore not be "confiscated." Rather, the world organization must pay for them at a price recommended by a small advisory committee and negotiated by the owners. In addition to softening the blow of losing their weapons, this compensation scheme might well add a further incentive to national compliance—if it didn't encourage them to go into the weapon-selling business! Thirdly, the composition of the U. N. force, the deployment of bases and storage depots, and the relation between the force and the other organs of the U. N. are all extremely delicate security considerations, and must be negotiated with great care—not necessarily at the outset, but at appropriate stages in the arms transfer process. The crucial thing is not to get agreement on all such details in advance, but to get iron-clad agreement on what the decision-making process will be, and how substantive agreements will be reached and disputes resolved. This, incidentally, is far easier to negotiate and settle prior to the emergence of specific issues than once the crisis has started. Also, if such procedures *are* firmly settled, negotiators can give in on substantive matters far more readily without loss of face.

VI. Conclusion

What I have tried to do in this paper is discuss the intimate inter-relationship between the development of military technology and the dominant characteristics of the international political system, by arguing that such development is both a

cause and consequence of these characteristics. The anarchistic nature of the system compels nations to invest in improving their weapons, with the nuclear-missile revolution an obvious result of the cold war coming hard on the heels of World War II.

Conversely, once such revolutionary weapons appear on the international scene they affect relations among nations in two rather paradoxical ways. One, because of the destructive power of the warhead and the rapidity and certainty with which the missile can deliver it, the nations find themselves more inhibited and restrained in their readiness to resort to force. But on the other hand, the strategic impact of these weapons is conducive to an increased level of fear, tension, suspicion, and the need for quasi-automatic, rapid-fire responses to many international events, none of which may necessarily be aggressive in intent. Faced with the distinct possibility of near-obliteration from surprise attack, the nations tend increasingly to strategies and capabilities conducive to an unintentional nuclear exchange.

Of the various approaches to an amelioration and elimination of such instability, the most promising seems to be a three-stage combination of over-lapping policies. First, a deterrent policy which eschews the provocative characteristics of counter-force target selection and pre-emptive timing, based primarily on an invulnerable retaliatory capability of unmistakably second-strike appearance. Second, a synthesis of unilateral and multilateral arms control measures, designed to provide a modicum of reassurance to the nations and hence some degree of stability to the nuclear-missile stand-off. Third, comprehensive global disarmament down to levels sufficient for domestic policing only.

But if the latter stage is to be achieved—and failure to do so virtually assures an ultimate nuclear holocaust—the nations must be willing to transfer most of their weapons and much of their hereditary license to supra-national political institutions. Faced with a choice between continuing the development and production of increasingly effective weapons

with a concomitant and perpetual instability on the one hand, and the establishment of effective international institutions which may eliminate war as an instrument of inter-nation conflict on the other, it may be hoped that statesmen will select the latter. Each approach has its risks and its dangers, but a reading of the record of man's folly suggests that the choice of disarmament through international government—though less likely—is greatly to be preferred.

GOVERNMENT AND INVENTION

Richard A. Tybout

THE FEDERAL GOVERNMENT TODAY provides roughly two-thirds of the total funds spent in the United States for research and development.[1] The social significance of this fact has largely gone unnoticed in the melange of space, atomic, and futuristic weapons technologies. Yet, it is a considerable departure from the pre-World War II pattern of invention.

Federal research and development (R & D) expenditures in 1940 accounted for $74 million of a total federal budget of approximately nine billion dollars, or less than one percent. By 1950, R & D had climbed to approximately three percent of a federal budget totaling almost $40 billion. And in 1960, $8.6 billion of $77.2 billion of federal expenditures, or 11.1 percent, went into research and development. The overall increase for the past two decades has been over 100 fold.

Table 1 shows the distribution of estimated R & D expendi-

Table 1
Estimated Research and Development Expenditures, Fiscal Year 1961, by Selected Federal Agencies

	(millions of dollars)
Department of Defense	6,123
Atomic Energy Commission	1,029
National Aeronautics and Space Agency	919
Department of Health, Education and Welfare	378
Department of Agriculture	146
National Science Foundation	111
All others	370
Total	$9,076

Source: U. S. National Science Foundation, *Federal Funds for Science*, Vol. IX (1960), p. 4.

1 U. S. National Science Foundation, *Federal Funds for Science*, Vol. IX (1960), p. iii.

tures for fiscal year 1961 among agencies accounting for $100 million or more. Approximately eight of the nine billion dollars of total R & D expenditure is being made by the three leading agencies, the program objectives of which are well-known at the general level. The actual conduct of total federal R & D work is divided among government, university, and industrial laboratories. The participation by each, in terms of fiscal year 1960 expenditures was: 23 percent government, 11 percent university, and 64 percent industrial (profit-making) institutions. The remaining two percent was divided among all others.

Of the three leading agencies shown in Table 1, Defense, AEC, and NASA, only AEC is vested with a primary responsibility for the development of civil applications. In point of fact, the history of technology shows that wars have markedly stimulated technological invention (though perhaps not basic science, which must always advance in the lead of invention). There is every reason to expect that commercial by-products will continue to result from defense programs and will follow from NASA activities as well as from AEC programs. The distinguishing feature of AEC is, then, that the public interest in by-product civil inventions is recognized.

The principal purpose of the present article is to explore the reciprocal influences between technological and social goals in the context of the current world conflict.

For a variety of reasons, this purpose is best served by reference to AEC policies. As explained above, these policies make explicit the relation between defense and civil technologies. The cold war is affected by technological change in at least three ways: in military capability, in economic productivity (especially of technologies suitable for underdeveloped economies), and in science for science's sake. No one sensitive to world politics can fail to appreciate the importance of the latter as it is manifested in Soviet-American rivalry for conquest of space.

AEC policies also afford a good testing ground for discussion of the issues because relevant information is available in

convenient form. NASA has hardly had the opportunity to generate by-product civil inventions. Defense offers many examples from the past in aviation, Diesel engines, electronics and elsewhere, but information is diffuse and difficult to organize. In contrast, AEC efforts have been a matter of public concern and subject to public scrutiny from the inception of the organization.

I. Atomic Energy Programs

Current American policy dates from the Atomic Energy Act of 1946. Primarily as a counter to the destructive potential of atomic energy, the 1946 legislation emphasized research on beneficial aspects and set up the Atomic Energy Commission as an independent body to administer both military and civil programs. Subsequent developments saw sweeping revision of atomic energy legislation in 1954 with the primary objective of permitting and encouraging private investment in nuclear facilities. Such facilities had previously been reserved exclusively for federal ownership.

Atomic energy expenditures up to the time AEC assumed control (January 1, 1947) reached a cumulative total of somewhat over $2.2 billion. The annual rates of expenditure have since increased from $478 million in fiscal year 1948 to $2,623 million in fiscal 1960, resulting in a cumulative total of $23.2 billion at the end of the latter fiscal year.

AEC activities fall naturally into three groups: procurement and production of nuclear materials, resulting in an expenditure of approximately $1,500 million in fiscal year 1960; weapons development and fabrication, with an expenditure of roughly $500 million; and reactor development and other research, accounting for the remaining $600 million-odd of 1960 expenditure. Research especially related to military programs has been assigned to the military group in the above figures. Procurement and production serves both of the other two programs, which can be viewed as the military and civil end-product groups, respectively.

The commercial by-products of atomic energy include especially radioisotopes and irradiations, atomic electric power, conceivably atomic motive power at some distant date, and, at least as nebulous from an economic standpoint, atomic explosives for non-military purposes. By far the greatest research and development effort has gone, and continues to go, into atomic electric power. The situation there will be the subject of future detailed discussion.

Radioisotopes have afforded the only real commercial gain to date, and these have been adapted to a variety of industrial purposes at purely nominal costs. AEC policy in making radioisotopes available to industry has been to levy a charge equal to out-of-pocket cost. Radioisotopes for scientific and medical research purposes have been made available on still more favorable terms. Industry uses radioisotopes primarily for nucleonic measurement and control systems. A private survey conducted in 1959 estimated that radioisotopes were saving American industry in the neighborhood of $300 million in raw materials alone. The conceptual difficulties, not to mention the data collection difficulties, preclude a more comprehensive measure of gain from industrial applications.

II. Reactor Development

At the considerable urging of Congress over the past seven or eight years, an extraordinary program of building atomic reactors has evolved. Private investments in power plants have been made and private supply industries for atomic equipment have grown up. AEC presents the schedule of additions to atomic electric generating capacity shown in Table 2. Since it takes about four years from drawing board to initial power generation, the schedule shown in Table 2 contains no speculative element in its forecast for 1962.

For the sake of a comparison, we note that the installed hydroelectric capacity of all Tennessee Valley Authority dams totals 3.75 million kilowatts. That is to say, the total atomic electric capacity shown in Table 2 is slightly over one quarter

Table 2
Domestic Atomic Electric Generating Capacity
by Year of Anticipated Initial Operation

	Capacity, in Kilowatts
Through 1958	75,500
1959	180,000
1960	110,000
1961	293,650
1962	355,100
Total	1,014,250

Source: U. S. Atomic Energy Commission, *Major Activities in the Atomic Energy Programs, January-December, 1960* (1961), p. 7.

the hydroelectric capacity of TVA. In contrast to the situation at TVA, however, none of the installed atomic power plants will produce electricity at a cost nearly as low as that of conventional coal-fired steam plants that could have been built instead. Atomic energy costs represented in the Table 2 tabulation range (or are expected to range) from two to seven times the costs per kilowatt hour of modern alternative coal-fired plants in the most favorable cases, that is, for large atomic electric plants having installed capacities on the order of 100,000 kilowatts or greater.[2] Fully allocated unit costs of smaller atomic power plants are greater.

[2] See the author's *Atomic Power and Energy Resource Planning*, Research Monograph 94, (Ohio State University Bureau of Business Research, 1958), pp. 31-34. Some of the electric utility companies responsible for the operation of atomic power plants included in the aggregate capacity data shown in Table 2 have announced costs which are almost as low as modern coal-fired steam-electric power. In cases where the author has seen such announced costs, they do not take account of all cost components that are considered for coal-fired plants. For example, the atomic power plant itself has on occasion been classified as a research and development expense and as a result is charged to other accounts not entering into the announced cost of atomic electric power generated. Since plant costs account for a large part of total costs of atomic electric power, their omission can have substantial effects. For a discussion of the relative importance of different categories of atomic power costs, see the author's "The Economics of Nuclear Power," *American Economic Review*, Vol. XLVII (May, 1957) pp. 351-360.

Various devices have been employed to defray the high costs of atomic power. They are sufficiently complex that the details cannot be presented here; I have treated the subject more fully in the third chapter of my book, *Atomic Power and Energy Resource Planning*. For present purposes, it will be sufficient to identify them by name: (1) federal (AEC) ownership of a part of the atomic power plant; (2) subsidy in the prices paid by AEC for certain by-product materials it will buy back from atomic power plants; (3) partial public indemnification of reactor plant operators; (4) special tax privileges for reactor plant owners; and (5) cost spreading through classification of cost accounts and through participation by a large number of electric utilities in groups for the financing of a single atomic power plant.

Projections of the cost of atomic power forecast downward trends as the lessons of atomic plant design and manufacture are learned. Most of the atomic electric capacity noted above in Table 2 has yet to come on the line. Cost estimates of atomic power, like cost estimates of other technological innovations, are not always the same as realized costs. The point is illustrated in Table 3 which gives an earlier survey of changes in estimated costs with progress toward completion of reactor projects. One is almost led to recommend that original cost estimates be multiplied by a factor of two when in doubt, and at least one year be added to the original estimate of time of first operation.

The same phenomena are found in defense planning for futuristic weapons. Hitch and McKean report in *The Economics of Defense in the Nuclear Age* (p. 252):

> Studies have been made of the reliability of early estimates of (1) cost, (2) development time, and (3) physical and performance characteristics of new, advanced weapons systems. The results are striking. In the case of estimates made at the preliminary design stage, costs are typically underestimated by factors of 2, 5, 10, or in some cases substantially more. Development time is typically underestimated by 1 to 5 years. And the final system differs markedly from the predicted system both in physical and performance characteristics.

Table 3
Comparative Cost and Schedule Estimates of
Electric Power Reactors

Reactor Code Name[a]	Cost		Date of Initial Operation	
	Original Estimate (millions)	Updated Estimate (millions)	Original Estimate	Updated Estimate
PWR–I	47.8	73.6	7/57	12/57
BWR–I	4.5	5.9	12/56	12/56
HRE No. 2	2.4	3.6	6/56	12/57
SRE	3.7	7.6	6/56	4/57
EBR–II	15.5	29.1	3/58	5/60
OMRE	2.6	2.6	9/57	b
SGR	25.1	50.2	1959	1962
PWR–II	32.9	57.5	1958	1960
FBR	48.5	51.1	1960	1960
BWR–II	6.2	11.9	1959	1960
SDR	7.4	11.1	1961	7/62
OMR	5.6	13.8	1961	2/61
NSP	21.6	21.6	6/62	8/62
ECF	25.8	c	6/63	c

Notes:
[a] Code conforms to AEC designations except where the latter would require too much space
[b] Not given
[c] Too recent for updating
Source: *Development, Growth, and State of the Atomic Energy Industry*, Hearings before the Joint Committee on Atomic Energy, 86th Congress, 1st Session (February 17, 18, 19, 24, 25, and 26, 1959), pp. 487–492.

Popular reports of progress in space technology suggest similar experiences. In all three fields—atomic energy, defense, and space—technologies are pressing hard on the frontiers of basic science. In view of the stakes in defense and space technologies, the reported results are not entirely surprising. But in civil applications of atomic power, the pattern —albeit in a milder form—leads one at least to inquire more deeply as to reasons and causes for our haste to install atomic electric generating capacity.

Atomic propulsion is further removed from commercial significance and no facts are known to the author with respect to the economics (and radiological problems) of civil uses of atomic explosives. Commercial atomic propulsion is only considered for such large installations as in the government's nuclear-powered demonstration ship, the N. S. Savannah which was scheduled to undertake her first sea trials in the spring of 1961. The only cost information known to the author is in the form of estimates made in the early stages of planning for the vessel. At that time (1956), an AEC spokesman estimated that capital costs would be seven times that of an equivalent horsepower oil-fired plant and nuclear fuel costs would be 50 times those of fuel oil for equal shaft-power generation.[3] For smaller vehicles, as locomotives or automobiles, or for individual house heating, atomic power would be hopelessly expensive.

III. Energy Resource Economics

Even before the end of the twentieth century, four important world regions will experience difficulties in achieving reasonable growth projections on the basis of home supplies of conventional fossil fuels; again, this topic has been discussed in the first chapter of my book. They are neutral Asia (excluding the Soviet Union, China, and the Middle East), Africa, South America (after exhaustion of oil reserves), and Oceania. Only North America, the Soviet Union, and China will be free of energy resource restrictions on economic growth by the end of the present century. Energy consuming nations elsewhere will be in greater or lesser degree fuel importers or will find ways to utilize atomic power or replaceable energy resources such as solar energy, falling water, and combustible vegetable matter. Careful analysis of the possibilities shows relatively limited expansion possibilities for the two latter,

[3] See testimony of Admiral H. G. Rickover, Panel on the Impact of the Peaceful Uses of Atomic Energy, *Peaceful Uses of Atomic Energy*, Vol. 2, Joint Committee on Atomic Energy, 84th Congress, 2nd Session (January, 1956), p. 241.

leaving the prospective future need dependent on developments in atomic and solar energy technologies.

Atomic and solar technologies have opposite economic characteristics, which in turn fit them for different roles in the satisfaction of world energy needs. These economic characteristics fall into two classes.

First, there are marked differences in economy of scale. Atomic power costs are lowest for the largest-scale reactors and increase rapidly per kilowatt of power with a decrease in plant size. This means that atomic power is best suited for only the largest bulk-energy applications. In contrast, there is no intrinsic characteristic of solar energy collectors which makes them more costly per power unit in smaller applications than in large, as J. A. Duffie and G. O. G. Lof have shown in their article, "Solar Energy," in *The Canadian Journal of Chemical Engineering* of April, 1959. Indeed, the most promising applications of solar energy are in small cookers delivering less than a kilowatt of heat, and in space heating (or cooling) of individual homes. Moreover, the total unit costs of solar energy for such uses in a number of world regions are as low as the alternative energy costs in those regions today.

Second, there are probable differences in cost structure. For the same total unit cost, atomic power appears to be more capital-intensive and less labor-intensive than some applications of solar power. The facts regarding atomic power technology are relatively well known, as I have discussed in my article, "The Economics of Nuclear Power." Solar technologies are various, but for the very reason of their variety, it would seem possible to choose from among them cost structures to suit economic conditions in different countries. To the extent afforded by such variability of cost structure, for example, scarce capital in underdeveloped economies can be used relatively less and abundant manpower relatively more.

Atomic power tends to be more suitable for economic conditions in mature economies, while solar energy tends to better fit the needs of underdeveloped countries. Large bulk-energy markets exist in advanced economies; relatively small

and often isolated markets for energy exist in underdeveloped economies. Cheap capital and relatively expensive labor in advanced economies fit better the cost structure of atomic energy while the opposite situation recommends solar energy for overpopulated nations in early stages of industrialization. Western Europe and Japan, already facing delivered fossil fuel costs twice those in the United States, are most likely to find atomic power useful. The underdeveloped economies, lying primarily in the sunlit regions of the world, are likely to find solar energy useful.

Unfortunately, the United States programs for aid to underdeveloped economies have not shown due consideration for these facts. An endless variety of financial, technological, training, informational, equipment, and other atomic energy aids have been made available through bilateral agreements with countries around the globe. Such agreements, and our atoms-for-peace program in general, have resulted in international good will. However, by the arguments of the preceding paragraphs, it is hard to believe that at least as much more good will could not be produced by a similar effort to aid underdeveloped (and other) countries to capture the energy released by the sun.

Solar energy research is conducted primarily at university-budget levels. If we are interested in the long-term energy resource problem, it would seem reasonable to expend at least as much effort on the development of solar applications as on atomic energy.

IV. Evaluation of Atomic Power Policy

The public interest in the development of non-military applications of atomic energy has been recognized, though less for the intrinsic economic significance of such by-products than as a symbol of America's peaceable intentions. In the light of world conditions, it would seem reasonable to take this approach. Commercial, medical, and other beneficial applications might be viewed as means to the end of proving a

peaceful atom and secondarily as contributions in their own right, judged by the standards applicable in their respective fields. At least this is an interpretation sympathetic to atomic power policy.

One might still wonder what end is served by building a million kilowatts of atomic electric power capacity in the United States. The usual explanation is that it is desirable to do this in order to advance technology. Common industrial practice, however, is to prove a technology somewhat more completely by pilot plant development before it is commercially introduced. The nearest analogue of the atomic power plants is probably in futuristic weapons development, where the necessity for operational systems employing up-to-the-minute science concepts is associated with the preservation of our national identity itself.

More likely, the attraction of a large installed kilowatt capacity in the United States is associated with American performance in what AEC ex-chairman Lewis L. Strauss has called the "atomic olympics." That is, the United States is held to appear more progressive than the Soviet Union in proportion to our larger installed atomic kilowatts of powerplant. Perhaps an analogy with military strategy will illustrate the point. It is usually held that a missile gap with the Soviets exists, but that a deterrent gap does not. Deterrence is achieved, it appears, as a result of our striking ability with the B-52 and other manned bombers. In the field of what we might call "technological showmanship," one can make the parallel argument that a space gap exists, but in overall performance, there is a standoff as a result of America's greater installed atomic kilowatt capacity.

The argument is not entirely convincing. If we are at a standoff in technological showmanship—and many would take exception to this premise—the question remains as to how much our installed atomic capacity has to do with it. More than installation of uneconomic power plants, our atoms-for-peace and foreign atomic aid programs, with their emphasis on international research, and our actual leadership

in atomic technologies are the foundations of our favorable international atomic energy reputation. It is perhaps significant that we have been able to negotiate bilateral (unclassified) scientific cooperation with the Soviet Union in atomic energy, but not in space exploration.

Technological showmanship, as any other showmanship, is most successful when it deals with true-to-life situations. The large installed atomic electric capacity in the United States is simply not evidence of true-to-life economic advantage. The power is costly in the narrow financial sense, and it is hard to believe that this fact can be glossed over by world opinion. We are inured to financial subsidies and can take them in our stride. There is much more reason to be concerned about environmental health and genetic consequences. But can we expect to sway world opinion by installing atomic power capacity so conceived and so understood?

There is a third area of international U.S.-U.S.S.R. rivalry. This is in the economic improvement of underdeveloped economies. Technological and economic considerations both play a part in this area, but technological advances are important because of their economic significance. The ends and the means trade places. In atomic power, technological change has been the end, with (supposed) economic advantage cast in a supporting role. In aid to underdeveloped areas, technological change is (or should be) judged in the light of economic advantages that might result.

When the latter view is taken, economic ends can be served by any technology. Solar energy becomes as worthy of consideration as atomic energy. The long-term energy resource problem is attacked in the context of cost-benefit calculations of alternative developments. The calculations include the financing of invention as well as the application of results.

Previous discussion has suggested that the gains of technological rivalry have been in atomic research and not in power production. The reason is that economic criteria have

not been dominant where in the name of logic one would expect them to dominate. The necessary reconceptualization of our interests would lead to an attack on the energy resource problem for its own sake and to a gamut of programs broad enough to contemplate the use of resources other than atomic energy.

V. The Collectivity of Knowledge

One can easily read into American atomic power policy a concern lest private enterprise not participate in all phases of the process of technological innovation. Such a concern is misplaced.

There is a natural responsibility of government to take the lead in basic science, just as in education, and for the same reasons. Both have to do with the improvement of knowledge, which in turn has the property of a collective good. That is to say, insofar as economics is concerned, the commodity known as "knowledge" has this quality; namely, that personal consumption by one member of society in no way reduces the whole or precludes consumption of the same knowledge by another member of society.[4] Like the enjoyment of a work of art, knowledge is collectively consumed by all who are exposed to it. Each economic unit in society benefits without preventing each other unit from deriving at least as much benefit. The quality of collectivity in consumption is, of course, true of other public goods, such as defense and national parks. It is not true of the various goods and services bought and sold in private markets: houses, automobiles, groceries, shoe shines, and so on.

The process of invention, of course, involves more than basic science. But the same principle of collectivity of knowledge applies to technologies no matter how specific. Specificity may or may not reduce the potential gain available to another from the use of knowledge. But it cannot remove the collec-

[4] This quality of collectivity is elaborated by Francis M. Bator, *The Question of Government Spending* (Harper and Bros., New York, 1960), pp. 93-98.

tivity characteristic of that knowledge. This line of reasoning leads one to question the very existence of a patent system for invention, though in the process of such questioning, one must recognize that there are other relevant considerations such as equity and the nature of incentives in invention. For present purposes, it is sufficient merely to note that economic theory provides no *a priori* defense of the patent system. Beyond this, certain aspects of atomic power policy suggest changes in the patent concept that might accompany an apparently growing part played by government in the financing of invention.

Patent policies among federal agencies can be ranked on a scale between two polar concepts. At one extreme is the view that any resulting patent rights should accrue to whoever finances the research. At the other extreme, patent rights are deemed to be the property of the contractor who actually conducts the research, on the ground that the knowledge necessary for producing the research result was somehow the property of the contractor. No government department fits either of these simple characterizations, but with some approximation, the Department of Agriculture can be associated with the first and Defense with the second. AEC policy tends to be more like that of Defense in principle, but like Agriculture in result. In point of fact, a large proportion of atomic energy patents are taken out by the AEC itself (and licensed to all who apply on a nonexclusive royalty-free basis), but the reason is that AEC has been the principal source of knowledge of atomic technologies. Similar reasoning in technological areas long supported by Defense funds could result in a larger proportion of Defense research results being held by patent in the public sphere.

VI. The Reactor Supply Case

Public patent rights are not enough, or may not even be important in determining the actual extent to which a competitive industry (and indirectly, public benefit) results from

federal research. The business firms that contract for the conduct of research gain experience with the new technologies. When, as, and if these technologies bear fruit commercially, it is hard to ensure an equal start for "insiders" (those who have held contracts) and "outsiders" (those who have not held contracts).

Recognizing the problem, AEC has undertaken far-reaching programs for the dissemination of information relevant for civil applications of atomic energy. These programs have included publications, classified and unclassified, library research and reference services, the granting of access permits for interested "outside" firms to study atomic technologies, and the conduct of training programs open to American industry in general. The results have been studied in the collection of product-classes known as the "reactor supply" industry. The members of this industry are private firms engaged in the production of, or research on, special components and other devices suitable only for nuclear reactors.

The results are interesting, as I have shown in my research monograph, *The Reactor Supply Industry,* 1960. Not very surprisingly, a large fraction (between one-third and one-half) of the successful business firms[5] in private reactor supply activities are insiders in the sense that they acquired their most valuable knowledge of atomic technologies while serving as prime or subcontractors of AEC.

A second large group of firms (roughly one-third of the total) acquired their most valuable technological abilities from either of two sources: hiring of key personnel or the open periodical literature, the first being twice as important as the second. Thus, full use of established channels of information and even more, a fluid, ample, professional manpower market can significantly broaden the competitive base for civil by-products.

[5] The use of the term "business firm" in this context involves an oversimplification. The study dealt with sources of information by product-classes. A given business firm might have produced in one or more product-classes and might have benefited most from different sources of information in the different product-classes. For this reason, the above results are only approximate.

The rest of the firms in the reactor supply industry obtained their most valuable technological knowledge in a number of different ways. The special AEC programs for access, training, and study made a surprisingly poor showing. The three of them put together received less total votes than the open periodical literature alone. The reasons for this result are not known, although a variety of tests was made in an attempt to find explanations.

In overall structure, the private reactor supply industry is at least as concentrated as, and perhaps more so than, its most closely related non-atomic counterparts in electronics and chemicals.[6] One might be led to infer that AEC experience provides little ground for hope in the efficacy of an institutional division of labor between public and private agencies in which the public sponsors the research and development while the private firms are concerned primarily with adaptations for commercial purposes. In principle, such a division of labor would appear to offer attractive possibilities for reconciliation of the requirements of modern research and effective competition in an industry having a much more complex technology than agriculture, where such an institutional pattern has been effective. In practice, the results have not been impressive, but neither are they entirely discouraging.

AEC programs for the development of a competitive structure in reactor supply are as well conceived as the author could suggest. It may well be that the time is too early to reach a conclusion. The programs have not been carried out for very long, as time is reckoned in the growth of industries. The use of atomic power is still in its infancy, still subsidized, still a pawn in world affairs, and for all of these reasons, still a risky place for private investment. Moreover, many members of the reactor supply industry are leading firms (or subsidiaries of firms) still strong in non-atomic products. As time passes, it is reasonable to expect that connections with older industries will be weakened and whatever concentrating influence carries over will be thereby reduced.

VII. Invention and the Cold War

The question of the part to be played by private enterprise arises especially because of a broadening of our goals of technological research and development.

Private industry has traditionally evolved in such a way as to serve a set of pragmatic objectives. In the United States, these objectives are worked out in the market place, in the councils of financial planning, and at the labor-management bargaining table. The industrial laboratory is the servant of these objectives. It is also the servant of Defense, AEC, NASA and, indirectly, the National Security Council. Very plausible arguments could be made to the effect that it should also directly serve the Department of State.

We are accustomed to raising the question of conflict of interest of our highly placed public officials. Without intending to be any more provocative, we might raise the same question of our private laboratory directors on government contract, or more to the point, of those who control the destiny of the laboratory directors. The same point has occurred to men of such dissimilar views and attainments as C. Wright Mills and Dwight D. Eisenhower. The cold war is being fought in the laboratories (public and private). More broadly, and perhaps without too much overstatement, a large part of international policy *and* the business future of the affected private firms are being simultaneously determined in the same laboratories.

The conflict-of-interest issue arises in a broad context and in a narrow context. At the broad level is the question of technological objective: whether to work for atomic energy or solar energy, or both; whether for improved manned aircraft, for ballistic missiles, or both, and in what proportions; and so on. The technological objectives must be related to broader social objectives such as have been discussed: the improvement of military capabilities, aid for economic development of underdeveloped countries, and that nebulous but important concept, scientific leadership for its own sake.

The distinction between public and private interest in the selection of social goals and technological means becomes a subtle matter when the number of laboratories (or organizations) capable of advancing these goals is quite limited. In such cases we are left with the indefinite but nonetheless imperative objective of assuring public responsibility. This is the objective at the heart of AEC's control system for private contractors managing publicly-owned atomic energy plants. Ensuring public responsibility simply makes more public various attributes of the affected organization; I have discussed the various ways in which public and private responsibilities are related in atomic energy production plants in my *Government Contracting in Atomic Energy,* 1956. In the limiting case, the organization in effect becomes another arm of government.

The next, or narrower, kind of problem involves conflict-of-interest only in the choice of a public policy, not in the area of technology as such. The problem is the same as illustrated above in the reactor supply case. There is a public interest in the commercial by-products of technologies developed for some other international goal and also a public interest in the maintenance of a competitive industrial structure, whether it be for a government-created or a consumer-created market. The only obvious method of satisfying these public interests is in the diffusion of knowledge and capability of using the relevant technologies, subject, of course, to whatever limitations on the dissemination of information are required in the interest of national security. It is noteworthy that AEC has found ways of reconciling national security control of information with its access program and also of relating declassification priorities to potential industrial value of results.

Be it noted: diffusion of technological capabilities is an opposite social process from that of assuring public responsibility by administrative controls. Where a significant number of producers are found, government can place more reliance on competition to ensure control, and less reliance on administrative relationships with a single contractor. Similarly in

private markets: where many sources of supply exist, the public interest in prices and profits is safeguarded to a greater degree by competition. Public regulation, directly or in subtle ways (and counter influences by the regulated) is less likely.

Certain characteristics of invention appear to limit the process to a small number of groups and hence to create the need for public responsibility. In particular, the need for teams of extremely specialized and organized research workers limits the number of such available groups. The necessary capital investment in expensive equipment works in the same direction. These characteristics are found to an outstanding degree in Defense and AEC research. They also appear in such industries as electronics and chemicals. To the extent that such characteristics are current, the press of public interest can only lead to administrative controls (or, a default of public interest can only lead to policy-making by special influence groups). Whether diffusion implemented by public policy can produce an opposite result remains to be seen.

American research and development is financed primarily with federal funds, and there is every expectation that public support of invention will continue to grow in the future. A principal concern is whether it will be directed with due consideration for total social goals. Atomic energy experience suggests something of the problems and prospects.

First, in the selection of technological areas for promotion, the results have not been reassuring. Radioisotopes have provided real commercial gain. But atomic power has been promoted in the face of benefit-cost comparisons which cast doubt on its value from almost every standpoint. Adequate consideration of social goals would postpone the installation of atomic power plants and would give greater attention to forms of energy more suitable for underdeveloped countries. Public policy has not considered the problem of energy development from a total social viewpoint. Nor have we conceived the process of invention in relation to social goals despite the magnitude of public investment in research and development.

Second, in the dissemination of new technologies, AEC experience illuminates problems previously unrecognized but nonetheless inherent in the reconciliation of public research and private industry. The most important consideration in this area is the existence of industrial competition in the use of the new technologies. Although civil by-products of cold war research are found in other than AEC programs, it is significant that the problem of ensuring competition in commercial applications elsewhere is hardly recognized.

The lessons of atomic energy policy are not limited to AEC matters. Research expenditures on the conquest of space in the 1960's are destined to reach a magnitude that will dwarf AEC programs. Defense research will overshadow both. The least we can ask is that federal research and technological results be guided to accord with total social goals.

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by Arnold Williams

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